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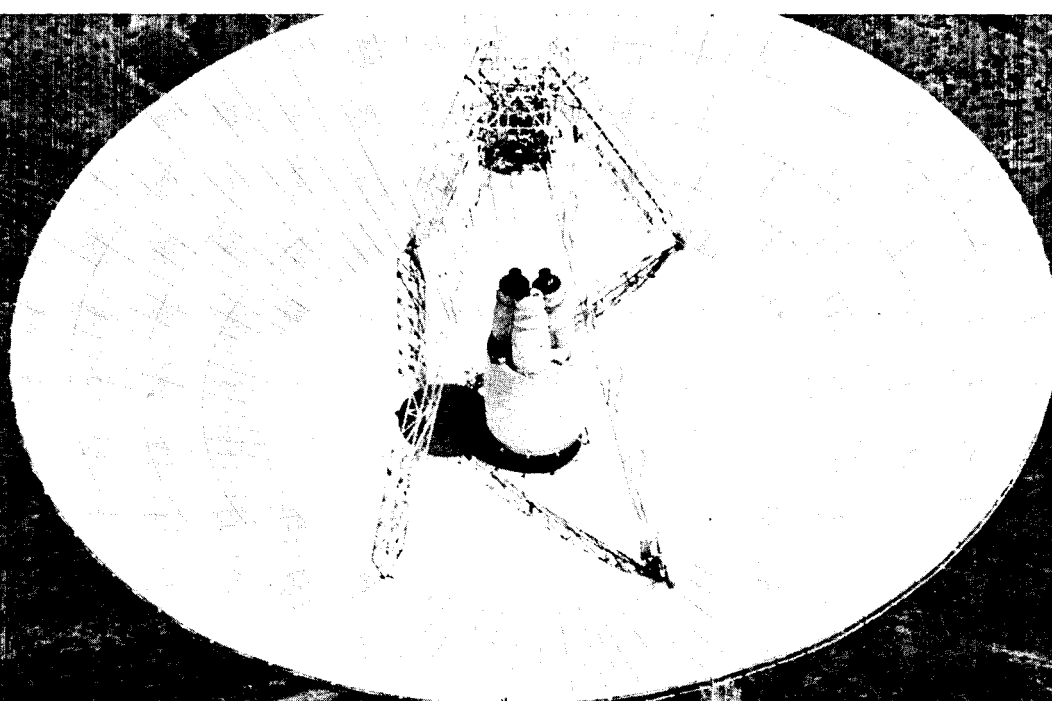
# Environmental Projects: Volume 7

## Environmental Resources Document

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# **Environmental Projects: Volume 7**

## **Environmental Resources Document**

**Goldstone Deep Space Communications Complex**

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## ABSTRACT

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 150 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California. A detailed description of the GDSCC is presented in Section II of this report.

The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each site is a Deep Space Station (DSS) that consists of a large parabolic dish antenna and its support facilities.

As required by NASA directives concerning the implementation of the National Environmental Policy Act (NEPA), each NASA field installation shall publish an environmental resources document (ERD) that describes the current environment at the installation and also includes any effects that NASA operations may have on the installation's environment.

M.B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL under Contract No. 957925-71070 to prepare the required ERD for the GDSCC.

This present report is an expanded JPL-version of the ERD submitted to JPL by MBGA on March 15, 1988. This ERD not only describes the existing environmental conditions at the GDSCC, but also documents the various possible effects of NASA/JPL operations at the GDSCC on the complex's diverse physical, biological, and social environments.



## GLOSSARY

AICP	American Institute of Certified Planners
AQMP	Air Quality Management Plan (South Coast Air Basin)
BLM	U.S. Bureau of Land Management
CDFG	California Department of Fish and Game
CEQ	Council on Environmental Quality (Federal)
CNDDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
CO	Carbon Monoxide
DSN	Deep Space Network
DSCC	Deep Space Communications Complex
DSS	Deep Space Station
EPA	U.S. Environmental Protection Agency
ERD	Environmental Resources Document
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FWS	U.S. Fish and Wildlife Service
GDSCC	Goldstone Deep Space Communications Complex
HC	Hydrocarbons
HEF	High Efficiency (Antenna)
JPL	Jet Propulsion Laboratory
kW	kilowatt
LPG	Liquified Petroleum Gas
MBGA	M.B. Gilbert Associates, Long Beach, California
MSL	Mean Sea Level

MTF	Microwave Test Facility
mw	microwave
NAS	National Audubon Society
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NO <sub>2</sub>	Nitrogen Dioxide
NSR	New Source Review (Air Pollution)
NTC	National Training Center (Fort Irwin, U.S. Army)
O <sub>3</sub>	Ozone
PV	Pressure Valve
R&D	Research and Development
RCN	Rural Conservation (Area)
SBAPCD	San Bernardino Air Pollution Control District
SCAG	Southern California Association of Governments
SEDAB	Southeast Desert Air Basin
SF	Square Feet
SO <sub>x</sub>	Oxides of Sulfur
STS	Space Transportation System (Space Shuttle)
TDS	Total Dissolved Solids
TSP	Total Suspended Particulates
UG	Underground
VOC	Volatile Organic Compounds

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## SECTION I

### INTRODUCTION

In 1978, the Federal Council on Environmental Quality (CEQ) issued regulations concerning the implementation of the procedural requirements of the National Environmental Policy Act (NEPA). In response to these CEQ-regulations, the National Aeronautics and Space Administration (NASA) published procedures to implement NEPA as subparts 1216.1 and 1216.3 of Policy on Environmental Quality and Control and Procedures for Implementing the National Environmental Policy Act. These subparts have been incorporated in the NASA Directives System as NMI 8800.7. As stated in subpart 1216.319, a description of an Environmental Resources Document follows:

"Each field installation director shall ensure that there exists an environmental resources document which describes the current environment at the field installation, including current information on the effects of NASA operations on the local environment."

M.B. Gilbert Associates (MBGA), Long Beach, California, was retained by the Jet Propulsion Laboratory (JPL), under Contract No. 957925, to prepare the GDSCC Environmental Resources Document (ERD) in compliance with the NASA handbook "Implementing the Provisions of the National Environmental Policy Act," NHB8800.11, 1980. The MBGA document serves as the ERD for the Goldstone Deep Space Communications Complex and describes the various environmental baselines for the evaluation of the effects of subsequent proposed actions and the determination of significant impacts. As required by the NASA directive, an ERD is not a static archival document but should be updated as required by changing conditions, and thoroughly reviewed and updated accordingly at 5-year intervals.

This present report is an expanded JPL-version of the ERD submitted to JPL by MBGA on March 15, 1988.

## SECTION II

### THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX (GDSCC)

#### A. LOCATION OF THE GDSCC

The Goldstone Deep Space Communications Complex (GDSCC) is located in southern California in a natural, bowl-shaped depression in the Mojave Desert, in San Bernardino County about 40 miles north of Barstow, California, and about 170 miles northeast of Pasadena, California, where the Jet Propulsion Laboratory (JPL) is located.

The GDSCC is part of the National Aeronautics and Space Administration's (NASA) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, California.

The 52-square-mile Goldstone Complex lies within the western part of the Fort Irwin Military Reservation (Figure 1). A Use Permit for the use of the land was granted to NASA by the U.S. Army. The Complex is bordered by the Fort Irwin Military Reservation on the north, east and southeast, the China Lake U.S. Naval Weapons Center on the northwest, and state and Federal lands managed by the U.S. Bureau of Land Management (BLM) on the south.

#### B. FUNCTIONS OF THE GDSCC

After the Space Act of 1958 had accelerated U.S. plans and programs for space exploration, JPL initiated construction work at Goldstone to build the first tracking station of what is now known as the Deep Space Network (DSN). The primary purpose of the DSN is to support the tracking of both manned and unmanned spacecraft missions and to provide instrumentation for radio and radar astronomy in the exploration of the solar system and the universe.

As indicated above, in addition to its participation in numerous scientific explorations, Goldstone performs the following functions in support of DSN operations:

- (1) Tracking: Locating the spacecraft, measuring its distance, velocity and position, and following its course.
- (2) Data Acquisition: Gathering information coming in from the spacecraft.
- (3) Command: Sending of instructions from the ground that guide the spacecraft in its flight to the target. Commands also tell the spacecraft when to perform required operations, including the switching on and off of instruments for performance of the mission's scientific experiments.

Goldstone also is a research and development center to extend the communication range and to increase the data acquisition capabilities of the

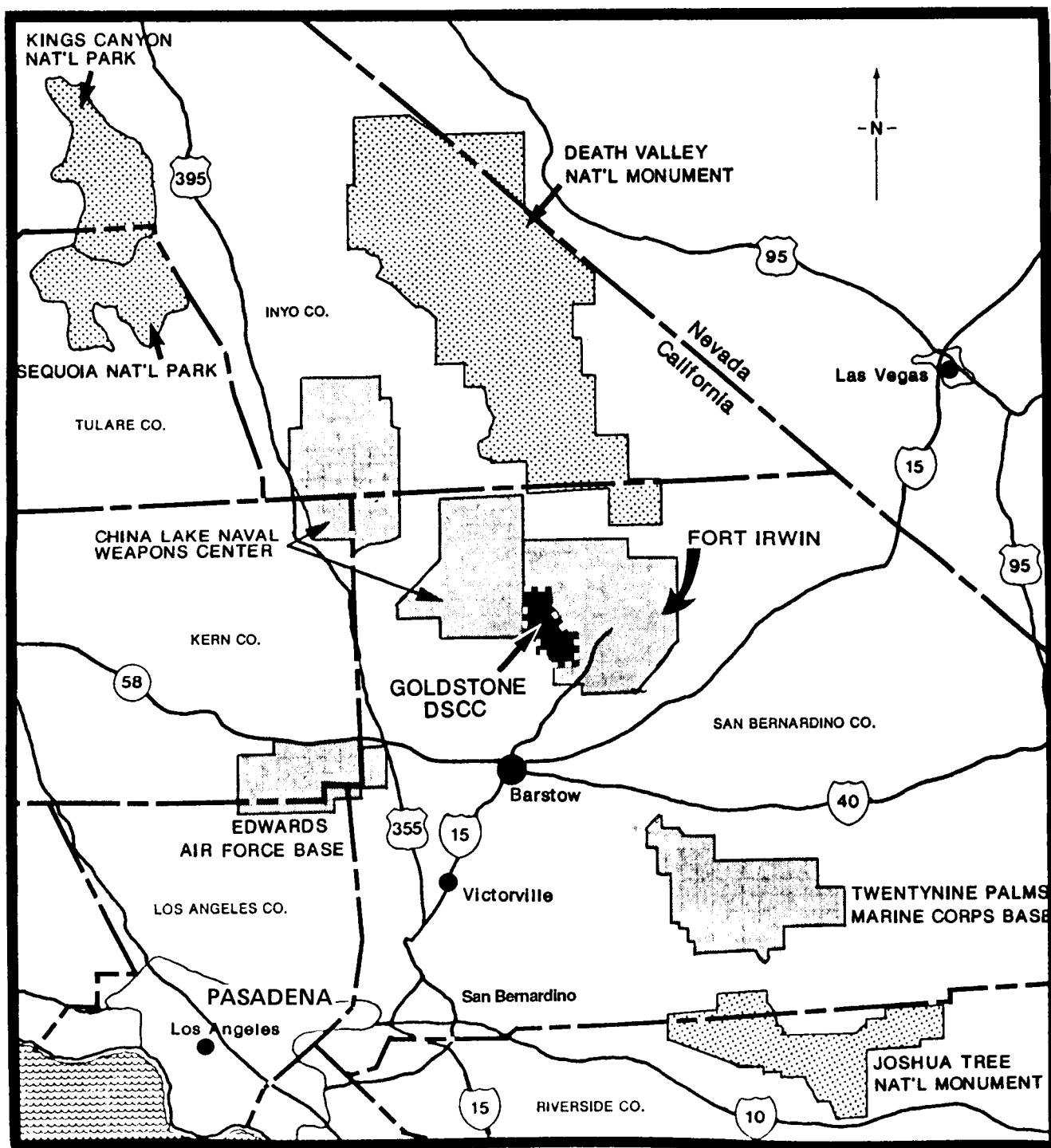


Figure 1. Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

DSN. It serves as a proving ground for new operational techniques. Prototypes of all new equipment are thoroughly tested at Goldstone before they are duplicated for installation at overseas stations (see Section II, C below).

### C. FACILITIES AT THE GDSCC

The GDSCC is a self-sufficient, working community with its own roads, airstrip, cafeteria, electrical power, and telephone systems and is equipped to conduct all necessary maintenance, repairs, and domestic support services. Facilities at the GDSCC include about 100 buildings and structures that were constructed during a 30-year period from the 1950s through the 1980s. The construction of additional buildings and structures continues today as the GDSCC increases its activities and operations.

Goldstone is one of three Deep Space Communications Complexes (DSCCs) operated by NASA/JPL that are located on three continents: at Goldstone in Southern California's Mojave Desert; in Spain, near Madrid; and at Tidbinbilla, in Australia, near Canberra. Because these three DSCCs are approximately 120 degrees apart in longitude, a spacecraft always is in view of one of the DSCCs as the Earth rotates on its axis (Figure 2).

Activities at the GDSCC operate in support of six, large, parabolic dish antennas, at sites called Deep Space Stations (DSSs): four DSSs are operational, one is devoted to research and development (R&D) activities, and one has been deactivated. There also are four, similar, operational DSSs in Spain and in Australia. Thus, the NASA DSN consists of a worldwide network of 12 operational DSSs. One of the six parabolic dish antennas at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA).

Total facilities at the GDSCC (Figure 3) include the six large, parabolic dish antennas, an airport, a microwave test facility, miscellaneous support buildings, and a remote support facility in Barstow located about 45 miles southwest of the GDSCC. The GDSCC support staff consists of 217 personnel on site and 65 personnel located at the Barstow facility. Table 1 summarizes the major facilities, buildings (number and square footage), and antennas (construction date and size). Three sites within the GDSCC have antennas (referred to as stations) devoted to NASA operations (Echo Site, Mars Site, and Apollo Site). Two other sites have antennas devoted to research and development: Venus, operated by the GDSCC, and Mojave, operated by the National Oceanic and Atmospheric Administration. A 26-meter (85-foot) antenna, located at the Pioneer Site was deactivated in 1981. In 1985, the Pioneer antenna was designated a National Historic Landmark by the U.S. Department of Interior and the Pioneer Site was returned to the U.S. Army. Each of the Goldstone sites is briefly described below.

### D. ANTENNA STATIONS AT THE GDSCC

#### 1. Echo Site (DSS-12)

The Echo Site, as the administration center and operations headquarters of the GDSCC, is the most extensively developed site on the complex. It has one 34-meter antenna and 24 support buildings having a combined area of 86,622 ft<sup>2</sup> (SF). Support buildings include administration

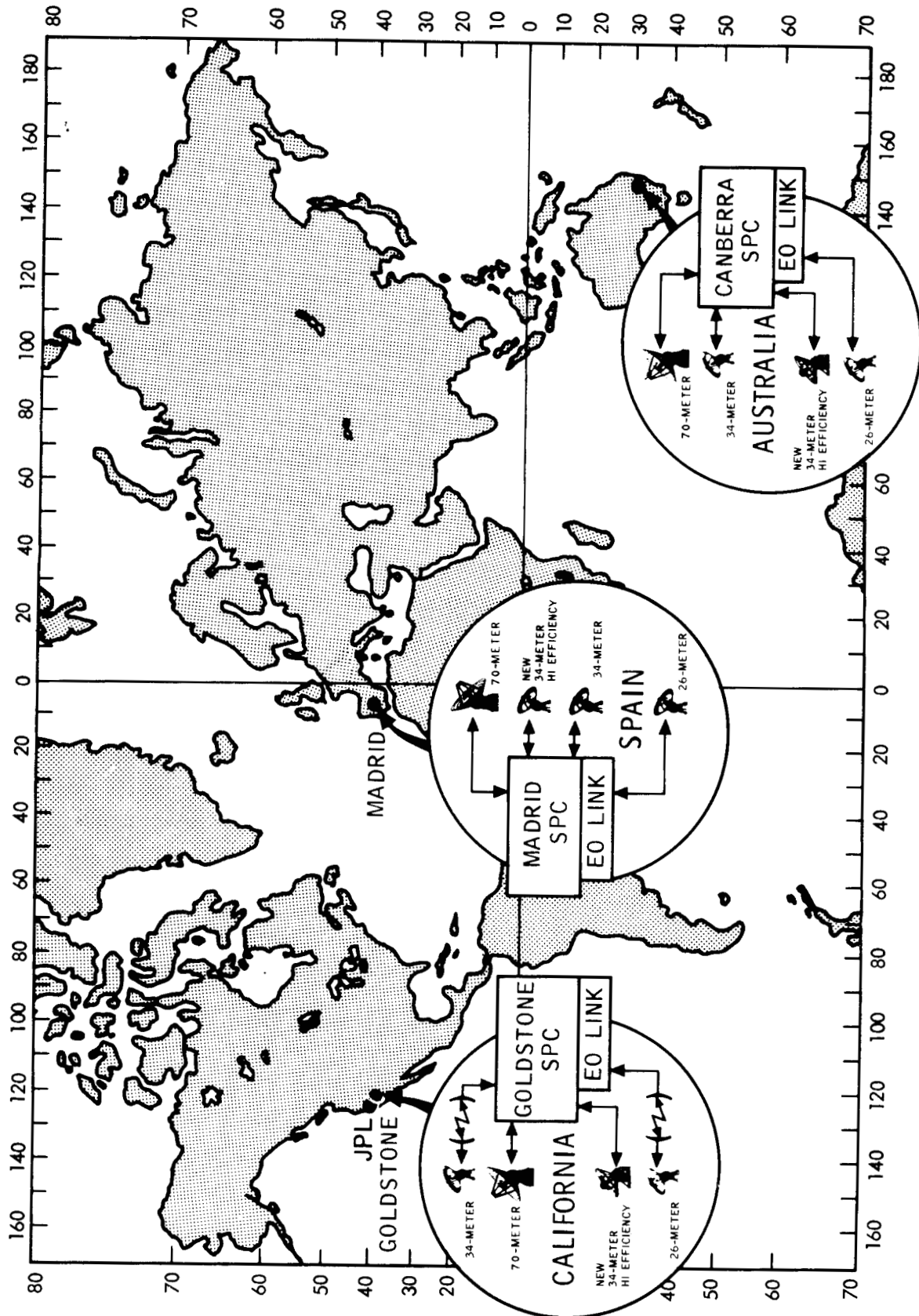


Figure 2. The Three-Continent NASA Deep Space Network as it Exists in 1988

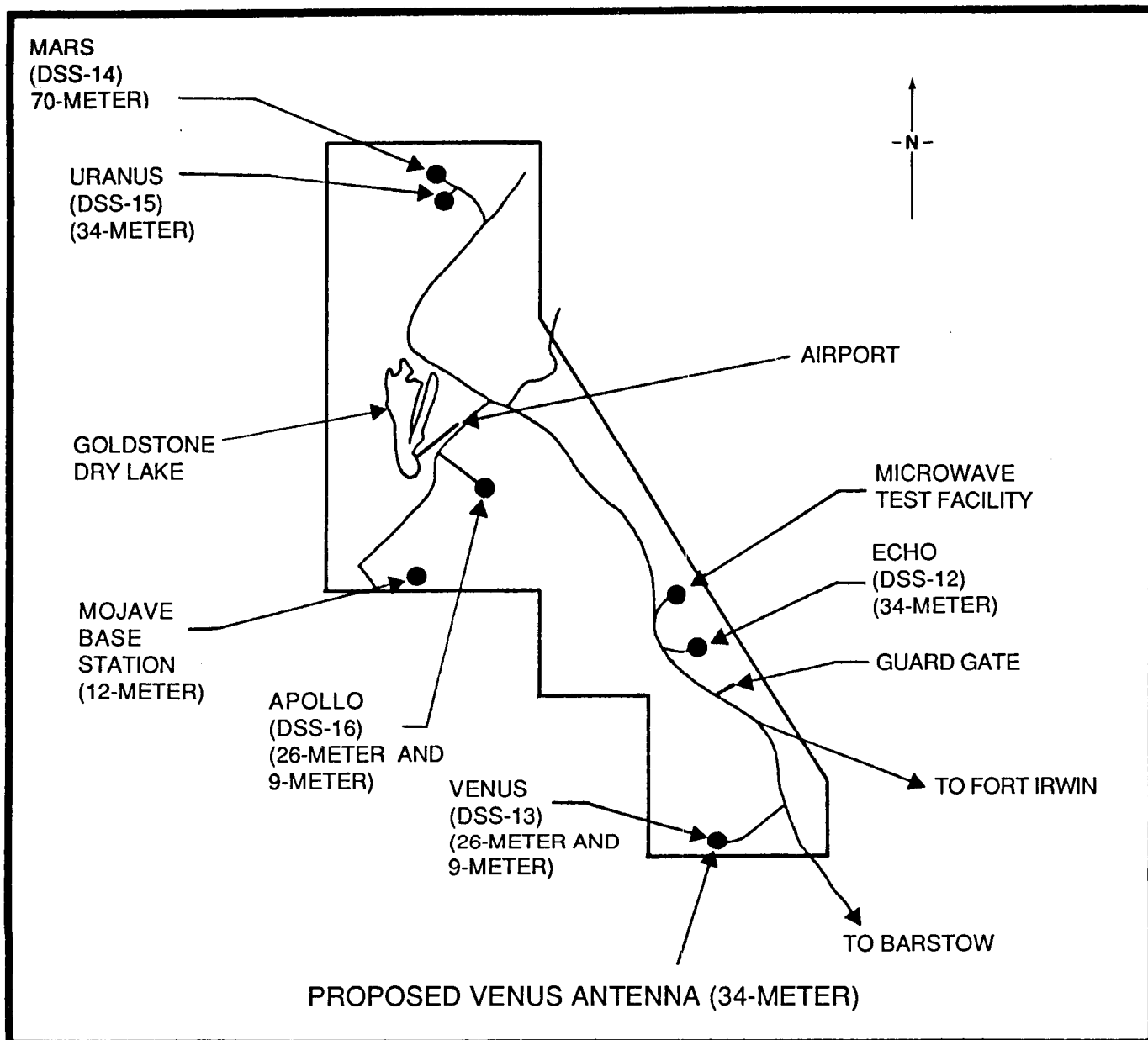


Figure 3. Schematic Map of the Goldstone DSCC Showing Locations of the Six NASA Deep Space Stations (DSSs)

Table 1. Major Facilities at the GDSCC

Site	Station Number	Buildings		Antennas	
		Number	SF (ft <sup>2</sup> )	Date of Construction	Size (Meters)
Echo Site	DSS-12	24	86,662	1961 <sup>a</sup>	34
Venus Site	DSS-13	12	12,502	1962 <sup>b</sup>	26 9
Mars Site	DSS-14	11	36,834	1988	70 <sup>c</sup>
	DSS-15			1984	34
Apollo Site	DSS-16	23	43,985	1965 <sup>d</sup>	26 9
Mojave Site		5	11,850	1964	12 <sup>e</sup>
Airport <sup>f</sup>		2	710	1963/1970	--
Microwave Test Facility	MTF	1	2,880	1963	--
Miscellaneous	--	3	1,430	--	--
Barstow Facility <sup>g</sup>		1	28,343	--	--

<sup>a</sup>Original antenna, built in 1959, was moved to Venus Site in 1962. A new 26-meter antenna, built in 1961, was extended to 34 meters in 1978.

<sup>b</sup>Antenna was constructed at Echo Site in 1959 and moved to the Venus Site in 1962.

<sup>c</sup>Originally constructed as a 64-meter antenna in 1966. Enlarged to a 70-meter antenna in 1988.

<sup>d</sup>Antenna originally was constructed for the NASA Goddard Space Tracking and Data Network. JPL/GDSCC/DSN operation of the antenna began in October 1984.

<sup>e</sup>This antenna is operated by the National Oceanic and Atmospheric Administration (NOAA).

<sup>f</sup>The airport is located at the Goldstone Dry Lake.

<sup>g</sup>This site, a leased facility, is located in Barstow, California about 45 miles southwest of the GDSCC.

Source: Directory of Goldstone DSCC Buildings and Supporting Facilities (Gold Book, Document 890-165, JPL internal document), Jet Propulsion Laboratory and National Aeronautics and Space Administration, December 1, 1985.

and engineering offices, cafeteria and dormitory facilities, transportation and maintenance facilities, storage areas, and warehouses. Echo Station originally was built in 1959 as a 26-meter (85-ft) antenna. The antenna was first used in 1960 in support of the Echo Project, an experiment to transmit voice communications coast-to-coast by bouncing radio signals off the reflective Mylar surface of a passive balloon-type satellite. In 1962, this original 26-meter antenna was moved to the Venus Site. In anticipation of this move, a newer 26-meter antenna had been built at the Echo Site in 1961. In 1978, this antenna was enlarged to 34 meters (111.5 ft).

## 2. Venus Site (DSS-13)

The Venus Site consists of a 26-meter (85-ft) antenna, a 9-meter (29.5 ft) antenna, and 11 buildings having a combined area of 12,502 SF. The support buildings provide space for operations control, laboratories, offices, security, workshops, warehouses, and mechanical equipment. The 26-meter antenna, which was originally located at Echo Site, was moved to the Venus Site in 1962. The antenna was used for a radar astronomy study of the planet Venus. Currently, its primary function is research and development and performance and reliability testing of high power radio-frequency transmitters and new systems and equipment prior to their introduction into the Deep Space Network. A new 34-meter (111.5 ft) antenna has been proposed to replace the 26-meter antenna. An Environmental Assessment concerning this new antenna is the subject of JPL Publication 87-4, Volume 6, Environmental Assessment: New 34-Meter Antenna at Venus Site (June 15, 1988).

## 3. Mars Site (DSS-14 and DSS-15)

The Mars Site consists of 2 antennas and 13 buildings with a combined area of 36,834 SF. The support buildings provide facilities for operations control, offices, training, mechanical equipment, storage, and security.

The Mars Station Antenna (DSS-14), at 70-meters (230 ft) in diameter, is one of the larger antennas of its kind in the world (see Front Cover). The antenna, which was constructed as a 64-meter antenna in 1966 and enlarged to 70 meters in 1988, is much more powerful and sensitive than a 26-meter antenna, extending the range of deep space communications several fold. It can maintain communications with spacecraft even to the edge of the solar system. Standing about 245 ft high, this antenna is one of the more striking features in the geographic area. The 70-meter antenna will be used for the Voyager 2 spacecraft's encounter with the planet Neptune in August 1989.

The Uranus Station Antenna (DSS-15) is a 34-meter, high efficiency (HEF) antenna, located approximately 1,600 ft southeast of the Mars Station Antenna. Built in 1984, this latest antenna-addition at the GDSCC first was used to support the encounter of the Voyager 2 spacecraft with the planet Uranus in January 1986. The new, proposed 34-meter antenna to be constructed at the Venus Site is similar in size and structure to this Uranus antenna.



#### 4. Apollo Site (DSS-16)

The Apollo Site has a 26-meter (85-ft) antenna, a 9-meter (29.5-ft) antenna, and 18 buildings having a combined area of 43,985 SF. The buildings provide space for operations, equipment, storage, and warehousing. The 26-meter antenna originally was constructed in 1965 by the NASA Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Operation of this antenna under the JPL/GDSCC/DSN began in October 1984. Both the 26-meter and the 9-meter antennas now are used to support the missions of the Space Shuttle (STS) and satellites in both low- and high-Earth orbits.

#### 5. Mojave Base Site (NOAA Antenna)

The Mojave Base Site has five buildings with a combined area of 11,850 SF. At one time, these buildings provided support facilities for operations, equipment, and maintenance. Except for the NOAA operations buildings, however, these buildings now are not in use.

The Mojave Base Station Antenna is a 12-meter (40-ft) antenna operated by NOAA. The antenna is involved in several programs including monitoring of shifts in the Earth's plates, monitoring weather changes, and retrieving information from very low orbiting Earth satellites.

### E. SUPPORT FACILITIES AT THE GDSCC

#### 1. Goldstone Dry Lake Airport

The airport consists of an approximately 6,000 ft by 100 ft paved runway. There are two buildings at the airport site, both of which now are not in use. An open hangar is used to provide shelter for a single aircraft. For its personnel, NASA operates three scheduled shuttle flights per week to the GDSCC that originate from the Burbank-Glendale-Pasadena Airport. In addition, the Goldstone airport is used infrequently by administrative Army flights. Both NASA and the U.S. Army use propeller-driven aircraft to land at the airport.

#### 2. Microwave Test Facility and Fire Training Area

The Microwave Test Facility (MTF) and Fire-Training Area consists of a single building of 2,880 SF along with areas identified for fire-fighting training. The MTF is used for research and development testing of antenna equipment. Fire training includes procedures for the quenching of fires.

#### 3. Miscellaneous Buildings in the GDSCC Area

Three buildings and structures at the GDSCC that fall into this category include the main gatehouse, pump house, and radio spectrum monitor. Total area of these three buildings/structures is 1,430 SF.

#### 4. Off-Site Facility at Barstow, California

In addition to the above-mentioned on-site facilities, the GDSCC leases an office and warehouse support facility in the nearby city of Barstow. The facility is a single story, 28,343 SF structure located at 850 Main Street.

#### F. NON-STRUCTURAL SUPPORT FACILITIES AT THE GDSCC

##### 1. Transportation Network

The major roadways in the area are shown in Figure 4. The only surface public transportation route to the GDSCC is by the Fort Irwin Road that leads to Fort Irwin. The NASA Road cutoff from Fort Irwin Road leads into the GDSCC. NASA Road merges with Goldstone Road, which is the only north-south paved access road within the complex. Both NASA and Goldstone Roads are paved two-lane roads and are maintained by the Ft. Irwin Post Engineer. Two-lane paved access roads also lead to each of the sites and major facilities.

##### 2. Utilities and Services

The Southern California Edison Company provides electricity for the Goldstone Complex. The GDSCC provides its own backup diesel-engine generators for operations during emergencies and to ensure continuity of electrical service for prescheduled periods of time. Gasoline, diesel oil, and hydraulic oil are stored in underground storage tanks. Water is supplied by Fort Irwin from groundwater basin wells. Sanitary sewage is discharged through septic tank systems to leaching fields. The Echo and Mars Sites also discharge wastewater to evaporation ponds.

#### G. WASTE-MANAGEMENT FACILITIES AT THE GDSCC

At the Echo Site, the GDSCC operates its own 10-acre, Class III solid-waste landfill. This facility, soon to be expanded to 20 acres, accepts only non-hazardous, solid wastes.

Most of a small quantity of hazardous waste, generated at the GDSCC each year, is sent to off-site commercial facilities for reclamation and eventual reuse. The remainder is transported to off-site commercial treatment or disposal facilities within 90 days of generation. The GDSCC maintains several properly managed waste-accumulation points, but operates no facilities requiring a hazardous waste permit. In accordance with its environmental management program, the GDSCC conducts all of its waste-management operations in strict compliance with environmental regulations, in a manner consistent with protection of human health and the environment.

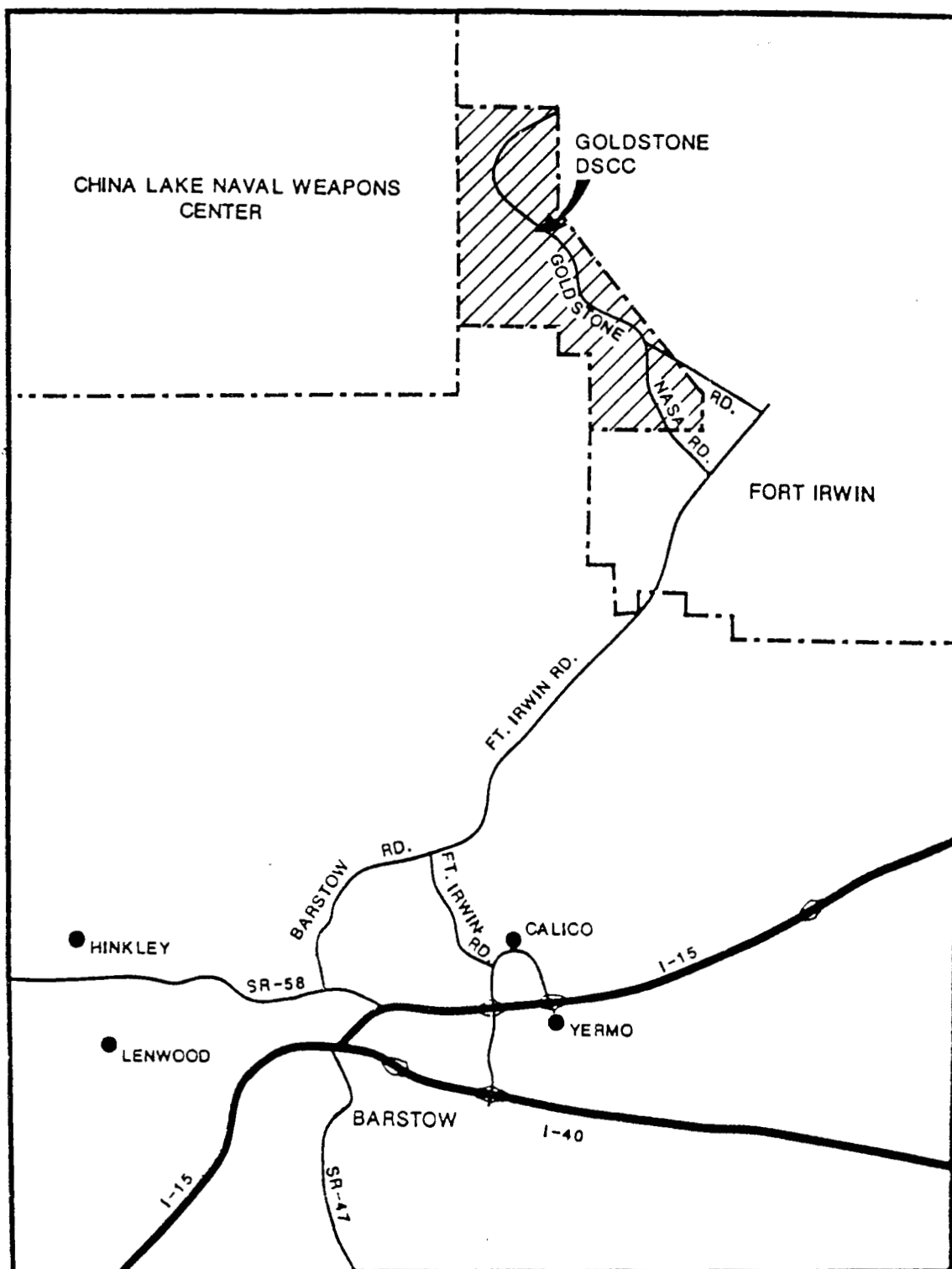


Figure 4. Major Roads Leading to and at the Goldstone DSCC

## H. OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN

Because the GDSCC is located within the Fort Irwin property, the two installations potentially can affect each other's roles and missions. Fort Irwin is a U.S. Army installation serving as the U.S. Army National Training Center (NTC). The remote desert environment allows military task forces to practice large-scale training maneuvers that could affect natural, historic, and cultural resources at the GDSCC. This especially is true when the maneuvers involve the movement of heavy equipment (tanks, large trucks) within the GDSCC. Most maneuvers occur at the eastern border of the GDSCC and every effort is made by both the GDSCC and Fort Irwin personnel to avoid the use of sensitive areas for such maneuvers.

## I. NATURAL ENVIRONMENTAL ASPECTS OF THE GDSCC

### 1. Geology

The GDSCC is located in a naturally-occurring, bowl-shaped depression bounded on three sides by geological faults. The Garlock Fault lies to the north, while the Blackwater and Calico Faults lie, respectively, to the west and south. The GDSCC is bounded on the east by the Tiefert Mountains. Each antenna site at the GDSCC is located on natural alluvial material, ranging in thickness from 15 ft at the Venus Site to more than 70 ft at the Echo Site. The alluvium is derived from the surrounding hills.

### 2. Hydrology

Groundwater in the Goldstone area is generally confined and is found at depths ranging from 170 ft near the Minitrack Site to approximately 1,000 ft below the Echo Site. Chemical analyses of the groundwater have yielded total dissolved solids (TDS) values in excess of 1,000 ppm indicating the groundwater is brackish. The Goldstone Complex currently obtains potable water from a group of wells located at Fort Irwin, approximately ten miles to the southeast.

### 3. Climatic Conditions

The GDSCC lies within the U.S. Naval Weather Service's Southwest Desert, Climatic Area A. Mean annual temperatures for the area range from 50° to 80°F. Temperatures can climb as high as 114°F during the summer months, and drop as low as 11°F during the winter months. Mean annual precipitation for the area is approximately 2.5 inches with most precipitation falling between November and February.

## SECTION III

### ENVIRONMENTAL RESOURCES AT THE GDSCC

#### A. INTRODUCTION

The National Aeronautics and Space Administration (NASA) has identified the following specific environmental resources that are to be described as part of an Environmental Resources Document:

- (1) Air resources
- (2) Water resources
- (3) Land resources
- (4) Biotic resources
- (5) Endangered species
- (6) Wetlands and floodplains
- (7) Solid waste generation, treatment, storage and disposal
- (8) Toxic substances
- (9) Pesticides
- (10) Radioactive materials and nonionizing radiation
- (11) Noise
- (12) Historical, archaeological and cultural factors
- (13) Economic, population and employment factors (NASA, 1980).

The discussions that follow for each of these resources describe the existing baseline conditions at the GDSCC and the potential impacts on these resources that may result from current and planned activities.

The Barstow office and warehouse facility is not discussed in this Section III, because it is located within a fully urbanized setting and its operations do not result in a significant impact on environmental resources.

#### B. AIR RESOURCES

##### 1. Description of Climate

Climatic conditions at the GDSCC are typical of high-desert locations. Summers are hot and arid while winters are relatively cool with little precipitation and frequent strong westerly winds. Average wind speed

in the area is 8 to 9 miles per hour. Significant precipitation occurs only three or four times per year with an annual rainfall of approximately 5.5 in.

## 2. Major Sources of Air Pollution

### a. Sources of Air Pollution that are Outside of the GDSCC

The GDSCC is located in an area known as the Southeast Desert Air Basin (SEDAB). Air quality in the SEDAB is a function of many factors: primary pollutants emitted locally, the existing regional ambient air quality, and the meteorological and topographical factors that influence the intrusion of pollutants from pollutant sources outside the immediate area.

A series of high mountain ranges (the San Gabriel, San Bernardino, and San Jacinto ranges) form a physical and climatological barrier between the SEDAB and the heavily urbanized South Coast Air Basin\*. The barrier, however, is incomplete as weather systems, cloud formations, and air contaminants still are able to move through and over the mountain ranges. The gaps that occur along this meteorological barrier are instrumental in allowing the transport of air pollutants from the South Coast Air Basin into the Southeast Desert Air Basin. The most important gap in the barrier is the San Geronimo Pass between the San Bernardino and San Jacinto Mountains, through which pollutants from the heavily developed South Coast Air Basin are transported. Although the South Coast Air Basin is recognized as the greatest contributor of air contaminants to the SEDAB, other pollutants also are transported directly over all the mountain ranges by convective chimney effects.

The city of Barstow is located in an area in which the levels of ozone in the air sometimes exceed the state standards for this air pollutant. The primary source of ozone is the South Coast Air Basin. During the four-year period from 1982 through 1985, there were 34 days in which the Barstow air quality monitoring station (the closest station to the GDSCC), recorded ozone concentrations that exceeded the state standard of 0.10 ppm (1-hour average). No other air-pollutant concentrations measured at the Barstow station during this same period (carbon monoxide, nitrogen dioxide, or total suspended particulates) were exceeded (California Air Resources Board, 1982 - 1985). The concentrations of these non-ozone air pollutants are thought to result primarily from local sources. Air quality data for 1982 through 1985 for the Barstow station are provided in Table 2.

In February 1979, the Southern California Association of Governments (SCAG) prepared the South Coast Air Quality Management Plan (AQMP) for the South Coast Air Basin. The California Air Resources Board then adopted a revised version of the AQMP in May 1979. This revised plan calls for a wide

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\*The South Coast Air Basin is a geographical area comprising 90 percent of Los Angeles County, 100 percent of Orange County, and 30 percent each of Riverside and San Bernardino Counties.

Table 2. Summary of Air Quality Data Obtained from the Barstow Air Quality Monitoring Station (1982 through 1985)

Pollutant <sup>a</sup>	Year Data Compiled <sup>b</sup>			
	1982	1983	1984	1985
Ozone (O <sub>3</sub> )				
State standard (1-hr avg) 0.10 ppm				
Highest concentration:	0.13	0.15	0.12	0.13
Number of days standard exceeded:	25	70	17	34
Carbon Monoxide (CO)				
State standard (1-hr avg) 20.0 ppm				
Highest concentration:	5.0	8.0	6.0	6.0
Number of days standard exceeded:	0	0	0	0
Nitrogen Dioxides (NO <sub>2</sub> )				
State/Federal standard (1-hr avg) 0.25 ppm				
Highest Concentration:	0.20	0.15	0.12	0.14
Number of days standard exceeded:	0	0	0	0
Total Suspended Particulates (TSP)				
Federal standard (24-hr avg) 150 µg/M <sup>3</sup> :				
Highest concentration:	116	87	144	128
Number of days standard exceeded:	0	0	0	0

<sup>a</sup> Neither oxides of sulfur nor hydrocarbons are monitored at the Barstow Station.

<sup>b</sup> As of September 1987, the 1986 data are not available from the California Air Resources Board. Source: California Air Resources Board, 1982, 1983, 1984, 1985.

range of emission control strategies designed to improve air quality in the South Coast Air Basin. It is anticipated that air quality in the SEDAB will improve and benefit from the control and mitigation measures implemented in the South Coast Air Basin, since the south coast area is a major source of pollutants for the SEDAB.

b. Sources of Air Pollution from Operations at both Fort Irwin and the GDSCC

While air quality data have not been collected for either Fort Irwin or the GDSCC, calculations of emissions from equipment in use at the GDSCC indicate that GDSCC operations do not substantially affect air quality in the SEDAB (Table 3). The San Bernardino Air Pollution Control District (SBAPCD) considers Barstow too remote from the GDSCC for the data obtained by the Barstow air quality monitoring station to reflect necessarily conditions at the GDSCC.

Emissions that originate from operations and activities at the GDSCC include such stationary sources as boilers, diesel engine-driven generators, fuel tanks, and miscellaneous equipment uses as well as such mobile sources as motor vehicles and occasional aircraft. A list of these sources is provided in Table 4. Estimates of current emissions from both mobile and stationary sources at the GDSCC are tabulated in Table 3. Based on these calculations, the GDSCC is not a major contributor to air pollution in the basin.

Because the San Bernardino Air Pollution Control District (SBAPCD) monitors air quality in the Goldstone area, the GDSCC is required to comply with appropriate SBAPCD regulations and must hold all permits presently required by the District. The diesel engine-driven electrical generators at the Mars and Echo Sites presently operate under peak-load clipping conditions on a one-year regular variance, pending completion of a New Source Review (NSR) determination and compliance plan by the SBAPCD.

C. WATER RESOURCES

1. Surface Water

There are no permanent surface streams at the GDSCC. Surface water flow occurs only after intense rainfall periods, with runoff quickly evaporating or infiltrating the dry desert soils. During heavy rainfall, water occasionally reaches Goldstone Lake, which becomes inundated for short periods. This intermittent water supply is inappropriate for domestic use due to its high levels of suspended and dissolved solids.

Several springs occur at Fort Irwin and within its immediate vicinity. The current status of these springs is not known. Several of these springs were developed in 1944 with substantial storage provided in underground redwood tanks (Department of the Army, 1979).



Table 3. Estimated 1987 Emission from both Mobile and Stationary Sources at the GDSCC (lbs/day)

Type	Stationary-Source Emissions	Mobile-Source Emissions <sup>a</sup>
LPG Tanks	Negligible	
UG Fuel Tanks, < 10,000 gal.	5.2 lbs VOC/day	
UG Fuel Tanks, > 10,000 gal.	0.03 lbs VOC/day	
Misc. UG Tanks <sup>b</sup>	Negligible	
Acid Tank, Spray Booth, Degreaser, Boilers	11.4 lbs VOC/day < 1 lb VOC/day 4 lbs NO <sub>x</sub> /day 1 lb SO <sub>x</sub> /day 1 lb CO/day < 1 lb TSP/day	
Diesel Generators <sup>c</sup>	6 lbs VOC/day 846 lbs NO <sub>x</sub> /day 93 lbs SO <sub>x</sub> /day 83 lbs CO/day 14 lbs TSP/day	
Sandblasters <sup>d</sup>		
Gasoline Dispensing Pump	8 lbs VOC/day	
Diesel Day Tanks	0.3 lbs VOC/day	
Solvents, Hand Wipe	27.6 lbs VOC/day	
Motor Vehicles		40.6 lbs VOC/day 80 lbs NO <sub>x</sub> /day 8 lbs SO <sub>x</sub> /day 420 lbs CO/day 14 lbs TSP/day
TOTALS: (lbs/day, emissions from stationary and mobile sources):	VOC 100.1 NO <sub>x</sub> 930.0 SO <sub>x</sub> 102.0 CO 504.0 TSP 29.0	

<sup>a</sup>Based on 100 average daily vehicle trips and a 40-mile trip length.

<sup>b</sup>Interceptor tanks for emergency use only.

<sup>c</sup>Based on 6 hr/day peak load clipping and 25 24-hr critical tracking periods during 1987.

<sup>d</sup>Seldom used.

CO = Carbon Monoxide

HC = Hydrocarbons

NO<sub>x</sub> = Oxides of nitrogen

SO<sub>x</sub> = Oxides of sulfur

TSP = Total Suspended Particulates

UG = Underground

VOC = Volatile Organic Compounds

gal = Gallons

Table 4. Inventory of Air Pollution Emission Sources at the GDSCC

Item	Site Location	Equipment Description	Permit Required	Permit Number	Comments
Inventory: Storage Tanks					
1	Echo	LPG Tank, 7'6" D x 37' L, 12,000 gal, PV @ 250 psig	No	None	
2	MTF	LPG Tank, 4' D x 28' L, 3,069 gal, PV @ 250 psig	No	None	
3	Venus 1A (East)	LPG Tank, 3'4" D x 17' L, 1,144 gal, PV @ 250 psig	No	None	
4	Venus 1B (West)	LPG Tank, 3'4" D x 17' L, 1,144 gal, PV @ 250 psig	No	None	
5	Venus 2	LPG Tank, 3'4" D x 18'6" L, 1,030 gal	No	None	
6	Echo G42-1G	UG Gasoline Tank, 2,000 gal, Subm. Fill Tube	No	T0001476	Inst. 1969 <sup>a</sup>
7	Apollo M27-1G	UG Gasoline Tank, 4,000 gal	Yes	T0001527	
8	Echo G24-1D	UG Diesel Tank, 12,000 gal	No	None	Inst. 1973
9	Echo G24-2D	UG Diesel Tank, 12,000 gal	No	None	Inst. 1973
10	Echo G27-1D	UG Diesel Tank, 12,000 gal	No	None	Inst. 1961
11	Echo G27-2D	UG Diesel Tank, 12,000 gal	No	None	Inst. 1961
12	Echo G27-3D	UG Gasoline Tank, 15,000 gal, with Dispenser	Yes	T001898	Inst. 1960
13	Mars G81-1DA	UG Diesel Tank, 12,000 gal	No	None	Inst. 1965 <sup>b</sup>
14	Mars G81-1DB	UG Diesel Tank, 12,000 gal	No	None	Inst. 1965 <sup>b</sup>
15	Mars G81-2D	UG Diesel Tank, 12,000 gal	No	None	Inst. 1984 <sup>c</sup>
16	Mars G81-3D	UG Diesel Tank, 12,000 gal	No	None	Inst. 1984 <sup>c</sup>
17	Apollo M9-1D	UG Diesel Tank, 24,000 gal	No	None	Inst. 1964 <sup>c</sup>

Table 4. (Cont'd)

Item	Site Location	Equipment Description	Permit Required	Permit Number	Comments
18	Mars 14-1 WO	UG Waste Oil Tank, 940 gal	No	None	Inst. 1973
19	Mars 14-2 WT	UG Interceptor Tank, 1,250 gal	No	None	Inst. 1983d
20	Mars 14-3 WT	UG Interceptor Tank, 1,250 gal	No	None	Inst. 1963d
21	Mars 14-1 HO	UG Hydraulic Oil Tank, 10,000 gal	No	None	Inst. 1971c
22	Mars 14-2 HO	UG Hydraulic Oil Tank, 10,000 gal	No	None	Inst. 1971c
23	Mars G39	Sulfuric Acid Tank, 400 gal, 4' x 5'4"	No	None	Inst. 1981
Inventory: Spray Booth, Degreasers					
24	Echo G-39	Spray Booth, 25' L x 15' W x 15' H, Metal Baffle Filter, 5 HP Exh. Fan	Yes	S000283	Air and airless guns used
25	Echo G-42	Cleanmaster Parts Washer, Model 70	No	None	
26	Venus	Ultrasonic Degreaser	No	None	Not used for about one year
Inventory: Boilers, Hot Water Heaters					
27	Echo G-21	Boiler, HW, 0.75 MM Btu/hr, LPG	No	None	
28	Echo G-23	Boiler, HW, 0.125 MM Btu/hr, LPG	No	None	
29	Echo G-26A	Boiler, HW, 0.5 MM Btu/hr (out), LPG	No	None	
30	Echo G-26B	Boiler, HW, 0.5 MM Btu/hr (out), LPG	No	None	

Table 4. (Cont'd)

Item	Site Location	Equipment Description	Permit Required	Permit Number	Comments
31	Echo G-26C	Boiler, HW, Unknown, LPG	No	None	
32	Echo G-33A	Boiler, HW/STM, 0.762 MM Btu/hr, LPG	No	None	
33	Echo G-33B	Boiler, HW/STM, 0.762 MM Btu/hr, LPG	No	None	
34	Echo G-33C	Boiler, HW/STM, 0.762 MM Btu/hr, LPG	No	None	
35	Echo G-33	Boiler, HW/STM, 0.45 MM Btu/hr, LPG	No	None	
36	Venus G-51	Boiler, HW, 0.125 MM Btu/hr, LPG	No	None	
37	MTF G-72	Boiler, HW, 0.125 MM Btu/hr, LPG	No	None	
Inventory: Diesel Engine Generators					
38	Echo G24-1	Cat. 398, 875 BHP, S/N 8194, 500 kW	Yes	Pending <sup>e</sup>	
39	Echo G24-2	Cat. 398, 875 BHP, S/N 8168, 500 kW	Yes	E000266e	
40	Echo G24-3	Cat. 398, 875 BHP, S/N 8169, 500 kW	Yes	E000267e	
41	Echo G24-4	Cat. 398, 875 BHP, S/N 8170, 500 kW	Yes	E000268e	
42	Echo G24-5	Cat. 398, 875 BHP, S/N 8171, 500 kW	Yes	E000269e	
43	Echo G24-6	Cat. D-353, 260 BHP, S/N 8087, 150 kW, Trailer Mounted	No	E001479	Emergency use
44	Venus 1	White Superior Model 40-SX-6, 500 BHP, S/N 8135, 350 kW	Yes	E000270	
45	Venus 2	White Superior Model 40-SX-6, 520 BHP, S/N 8117, 350 kW	Yes	E000271	

Table 4. (Cont'd)

Item	Site Location	Equipment Description	Permit Required	Permit Number	Comments
46	Mars G81-1A	Cat. 398, 875 BHP, S/N 8113, 500 kW	Yes	E000280	e
47	Mars G81-2A	Cat. 398, 875 BHP, S/N 8114, 500 kW	Yes	E000279	e
48	Mars G81-3A	Cat. 398, 875 BHP, S/N 8115, 500 kW	Yes	E000281	e
49	Mars G81-4A	Cat. 399, unknown, 875 BHP, S/N 8132, 500 kW	Yes	E000278	e
50	Mars G81-1B	Cat. 399, 1280 BHP, S/N 8164, 750 kW	Yes	E000275	e
51	Mars G81-2B	Cat. 399, 1280 BHP, S/N 8165, 750 kW	Yes	E000274	e
52	Mars G81-3B	Cat. 399, 1280 BHP, S/N 8166, 750 kW	Yes	E000276	e
53	Mars G81-4B	Cat. 399, 1280 BHP, S/N 8167, 750 kW	Yes	E000277	e
54	Mars G81-1C	Cat. 398, 875 BHP, S/N 8134, 500 kW	Yes	E000272	From Pioneer
55	Mars G81-2C	Cat. 398, 875 BHP, S/N 8133, 500 kW	Yes	E000273	From Pioneer G3-3e,f
56	Apollo M9-1	Cat. 379, 600 BHP, S/N 68B343, 250 kW	Yes	E000260	
57	Apollo M9-2	Cat. 379, 600 BHP, S/N 68B342, 250 kW	Yes	E000261	
58	Apollo M9-3	Cat. 353, 260 BHP, S/N unknown, 250 kW	No	None	
59	Apollo M9-4	Cat. 353, 260 BHP, S/N unknown, 250 kW	No	None	
Inventory: Miscellaneous					
60	Echo 3-A (STGE yard)	Kelco Model 125 Sandblaster, Portable	Yes	A001896	
61	Echo G-28	Thompson Surface Grinder	No	None	Seldom used

Table 4. (Cont).

Item	Site Location	Equipment Description	Permit Required	Permit Number	Comments
62	Facilities Workyard #4	Sandblaster, Portable	Yes	A001897	
63	Echo	Gasoline Dispensing Pumps (to vehicles)	No	None	
64	Apollo M-9	Day Tank, Diesel, 500 gal	No	None	
65	Echo G-24	Day Tank, Diesel, 500 gal	No	None	
66	Venus	Fire Training Site incl. LPG Burner	Yes	g	Seldom used
67	Mars G-81	Day Tank, Diesel, 500 gal	No	None	
68	MTF	Day Tank, Diesel, 500 gal	No	None	
69	Apollo A-6 (outside)	Gasoline Engine Generator, Emergency	g	g	Belongs to telephone co.
70	Venus	Underground Interceptor Tank, 1700 gal	No	None	Emergency
71	Echo G-39	Heat Lamp Bank (infrared & incandescent) for drying	No	None	
72	Echo G-47	Carpentry Shop	No	None	
73	All sites	Use of solvents for cleaning by hand wiping	No	None	

Inst = installation date    LPG = Liquefied Petroleum Gas    psig = pounds per square inch gauge  
 Btu = British thermal unit    S/N = Serial Number    PV = pressure valve    HW = hot water  
 BHP = brake horsepower    UG = underground    STM = steam

a Tank has been emptied, cleaned, inerted and sealed pending removal in accordance with county requirements  
 b Two 12,000-gallon tanks manifolded together for about two years  
 c Stand-by use  
 d Emergency use  
 e Application submitted for use during peak-generating times  
 f Not yet operating at the Mars Site  
 g Not enough information, but as a source of air pollution it was judged to be too small to require permit

## 2. Subsurface Water Resources

The entire Mojave River Basin draws its water supplies exclusively from the groundwater basin, which is recharged by two sources: rainfall and the Mojave River. Previous hydrologic investigations, as well as various U.S. Army Corps of Engineers memoranda on well drilling, indicate that groundwater occurs principally in alluvial deposits underlying valleys and basins within Fort Irwin. These alluvial materials consist of mixtures of clay, silt, sand, gravel, and boulders, distributed in layers and irregular lenses that reach aggregate thicknesses of several hundred feet. The alluvial materials have been derived from the adjacent mountains that are composed mainly of volcanic and granitic rocks (Department of the Army, 1979).

Fort Irwin has a total of 11 water-supply wells located within its boundary. Eight of these 11 wells are located within the main cantonment area; the remaining three are located in the immediate vicinity of Bicycle Lake. Of these 11 wells, nine presently are active water-producers.

The eight wells located within the main cantonment area tap artesian aquifers contained in a closed alluvial valley. An artesian aquifer is a water-saturated layer of permeable material sandwiched between two impermeable layers above and below it. The water levels in wells that have penetrated an artesian aquifer will reach a level above that of the top of the aquifer, because the aquifer is under pressure due to the sandwiched confinement. When water levels drop due to pumping, the aquifers reach free water-table conditions. At the well sites, the saturated aquifer zones are 170 to more than 360 ft thick and are capped by a confining bed of low permeability that ranges in thickness from 130 to 245 ft. The elevation of the piezometric surface (i.e., the water level in a well that penetrates a confined aquifer) was about 2,280 ft above mean sea level (MSL) in July 1974. The lowest recorded level was about 2,271 ft above MSL in May 1970 (Department of the Army, 1979).

The present source of all water used at the GDSCC is a group of six wells located within Fort Irwin. Water from these wells is pumped from the Fort Irwin area to the GDSCC. The availability of water is one of the more critical challenges facing the GDSCC and its neighbors throughout the Mojave River Basin. It has been recognized since the 1920's that the Mojave River Basin water supply cannot adequately support more than minimal growth and development. Furthermore, the overdraft of ground water supplies has been recognized since 1967, when it was estimated by the California Department of Water Resources that withdrawals exceeded recharge by 38,350 acre-feet per year (Michael Brandman Associates, 1978). One acre-foot is equivalent to 325,900 gallons.

A Water Resources Study Report dated June 30, 1962, EPD-102, prepared by the Jet Propulsion Laboratory (JPL, 1962) indicates that four wells are known to be located within the GDSCC. The wells, located south of Goldstone Lake, contain water with elevated levels of the following naturally occurring substances: chlorides, iron, and total dissolved solids. None of these wells now are being used as a source of water for the GDSCC.

Water supplies from both the Fort Irwin and Bicycle Lake groundwater basin are estimated to yield no more than 10 to 12 additional years supply of water. An additional 20 years' supply of water is projected for the Langford Groundwater Basin located at Fort Irwin. The Langford Basin currently is not in production. To provide water supplies after depletion of the Irwin, Bicycle, and Langford groundwater basins, the U.S. Army has secured water entitlements in the nearby Coyote Basin, which has an estimated 7.9 million acre-feet of production capability. This is estimated to be equivalent to an 878-year supply of water.

### 3. Water Quality

In general, water from wells and springs within Fort Irwin is potable, although generally high in fluorides and occasionally high in iron, boron, and nitrates. Water from producing wells is chlorinated prior to entering the Fort Irwin storage and distribution system. Water for consumption purposes passes through a fluoride treatment plant to reduce fluoride content to acceptable limits. State water quality parameters and objectives are listed in Table 5. U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels for Federal Primary and Secondary Drinking Water Standards are presented in Table 6. Fort Irwin well water exceeds EPA Maximum Contaminant Levels for iron and manganese. These constituents can probably be reduced to acceptable limits by blending waters from various wells (RMS Corporation, 1982).

## D. LAND RESOURCES

### 1. Land Use

#### a. Existing Land Use

##### (1) Goldstone Deep Space Communications Complex

Existing land uses at the GDSCC are described in Section II. The complex represents an extremely low-intensity development for its 52-square mile size. With its high sensitivity to physical and electromagnetic interference, however, significant changes to land use in the immediate or surrounding vicinity at the GDSCC could jeopardize radio transmissions and receptions by the various antennas. The land uses of the areas surrounding the GDSCC are depicted in Figure 5 and are described in the following sections.



Table 5. State Water Quality Objectives for the South Lahontan Basin in which the GDSCC is Located

Constituent	Unit	Standard
pH	pH units	6.5-8.5
Dissolved Oxygen	mg/l	
Warm		Not to exceed 5.0 mg/l.
Cold		Not to exceed 7.0 mg/l.
Fecal Coliform (Membrane Filter Technique)	cells/ 100 ml	Not to exceed one cell per 100 ml (monthly).
Temperature	°F	Shall not be increased by more than 50°F above natural receiving water temperature.
Oil and Grease		Shall not contain concentrations that result in a visible film or coating on the surface of the water or on objects in the water that cause nuisance, or that otherwise adversely affect beneficial uses.
Total Suspended Solid	mg/l	500 to 1,500.

Source: California Regional Water Quality Control Board, 1975.

Table 6. Maximum Contaminant Levels for Federal Primary and Secondary Drinking Water Standards (40 CFR 141.11 AND 143.3, July 1986).

Contaminant	Level (mg/l)
Primary Maximum Contaminant Level:	
Arsenic	0.05
Barium	1.
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate (as Nitrogen)	10.
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP	0.01
Total Trihalomethanes	0.10
Turbidity	1-5 units
Coliform	1 cell/100 ml/month
Radium-226 and 228	5 pCi/l
Gross Alpha	15 pCi/l
Beta Particle and Photon	Annual dose equivalent not to exceed 4 millirem/yr
Secondary Maximum Contaminant Level:	
Chloride	250.
Color	15 color units
Copper	1.
Corrosivity	Noncorrosive
Fluoride	2.0
Foaming Agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 Threshold odor number
pH	6.5-8.5 Units
Sulfate	250.
Total Dissolved Solids	500.
Zinc	5.

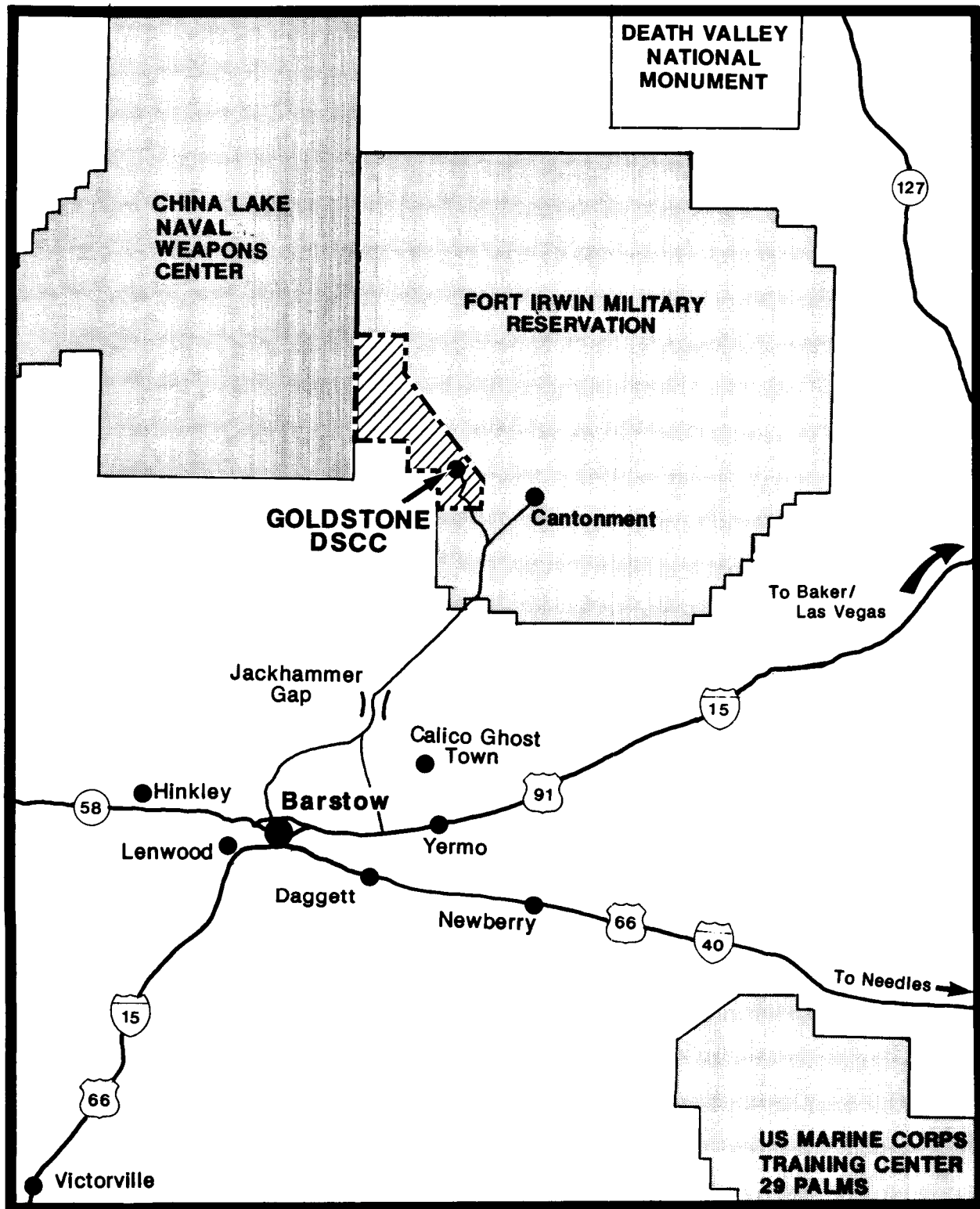


Figure 5. Land Use Map of the  
GDSCC and its Environs

## (2) Fort Irwin

The GDSCC lies within Fort Irwin, a U.S. Army installation under the control of the U.S. Army Forces Command. Fort Irwin serves as the U.S. Army National Training Center (NTC) and in 1986 had more than 3,700 active duty military personnel along with 4,300 family members. The installation also employs 750 Department of the Army civilians and 1,850 contract civilian workers.

The NTC conducts training activities designed to prepare battalion task forces for combat. With Fort Irwin bordering the GDSCC on the north, east, and southeast, the potential for incompatible activities and actions exists unless both facilities operate in a cooperative manner. Of primary concern are the approximately five "critical" and 35 to 40 "semi-critical" days per year when GDSCC transmissions require absolute freedom from physical and electromagnetic interference. While critical-day activities have not been violated up to this time, this is still an area of concern. Memoranda of understanding have been signed addressing each agency's responsibility.

## (3) China Lake Naval Weapons Center

The China Lake Naval Weapons Center Mojave "B"-Randsburg Wash Test Range Complex lies directly west of the GDSCC. The mission of the Naval Weapons Center is to establish and maintain the primary in-house research and development capability for the following Navy and Marine Corps systems, subsystems and technologies (Department of the Army, 1979):

- (a) Strike aircraft/weapons systems and concept development
- (b) Air-launched weapons and associated avionics systems
- (c) Tactical missiles
- (d) Subsystems for above-defined weapon systems
- (e) Strike warfare countermeasures
- (f) Weather modification

The Mojave "B"-Randsburg Wash Test Range Complex has been used for joint training military exercises with Fort Irwin. With the GDSCC lying between and separating these two military installations, military equipment commonly is transported across the GDSCC using both Goldstone Road and unpaved roads.

## (4) County of San Bernardino

The GDSCC lies within the county of San Bernardino, the largest county in the nation. Land immediately south of the GDSCC consists primarily of public lands administered by the U.S. Bureau of Land Management

(BLM). The county of San Bernardino General Plan has designated all properties at least 10 miles south of the GDSCC as Rural Conservation (RCN) areas (San Bernardino County, 1986). The RCN designation permits a variety of low-intensity land uses such as agricultural croplands, mining areas, national forest, wilderness and residential units. The area is zoned DL-40, which restricts lot size to no less than 40 acres. More intense development, such as two dwelling units per 40 acres, would require administrative site plan approval with proposals for three or more dwelling units per 40 acres requiring County of San Bernardino Planning Commission approval.

(5) City of Barstow

The city of Barstow, incorporated in 1947, encompasses 22 square miles. With no housing facilities at the GDSCC, most GDSCC employees reside in Barstow. As shown in Table 7, the population of the city of Barstow has remained relatively stable, increasing less than 13 percent from 1970 to 1985. Much of this increase can be attributed directly to establishment of the National Training Center at Fort Irwin in 1980.

Table 7. Population Growth of the City of Barstow

Year	Population
1940	Not incorporated
1950	6,135
1960	11,644
1970	17,442
1980	17,690
1985	19,700

Source: Compiled from statistics of the California State Board of Equalization, the U.S. Post Office, and the U.S. Census Bureau.

Fort Irwin is a major contributor to Barstow's economy. The GDSCC, with only 282 employees contributes to a lesser extent. The city of Barstow benefits from both of these facilities through consumer spending and direct employment opportunities.

b. Plans and Policies

(1) Goldstone Deep Space Communications Complex

Current plans at the GDSCC include the construction of two new proposed facilities: the 34-meter waveguide antenna at the Venus Site and a maintenance and integration building at the Mars Site. The proposed 34-meter Venus antenna (Figure 6) is to be used for research and development purposes. More specifically, the antenna will increase scientific returns, improve antenna microwave optics, improve performance of both transmitting and receiving capabilities, and improve antenna pointing, spacecraft tracking and spacecraft navigation. The existing 26-meter antenna at the Venus Site will be replaced with the proposed 34-meter antenna.

A 5,000 SF metal prefabricated building is proposed to house maintenance and integration operations at the Mars Site. Most of these operations now are located at the Echo Site. This project will provide greater operational efficiency and is scheduled for completion in late 1988.

(2) Fort Irwin

Staffing of the National Training Center at Fort Irwin began in 1980 and now is complete. Fort Irwin is planning to construct 525 new on-base housing units to meet increased housing demands. An environmental assessment was prepared in 1986 and the housing units are planned for occupation by 1989. This project will not impact antenna operations at the GDSCC.

(3) China Lake Naval Weapons Center

The China Lake Naval Weapons Center land to the west of the GDSCC is largely undeveloped and is expected to remain at its current level of usage.

(4) County of San Bernardino

The property to the south of the GDSCC is characterized by BLM land interspersed with noncontinuous private ownership. This discontinuity of ownership represents a barrier to effective land use planning. In recognition of this problem, San Bernardino County approved a joint resolution calling for consolidation of discontinuously held parcels in the area. While the joint resolution contains no enforcement provisions, it has established a policy statement that may assist in the establishment of a continuous buffer zone around installations such as Fort Irwin and the GDSCC.

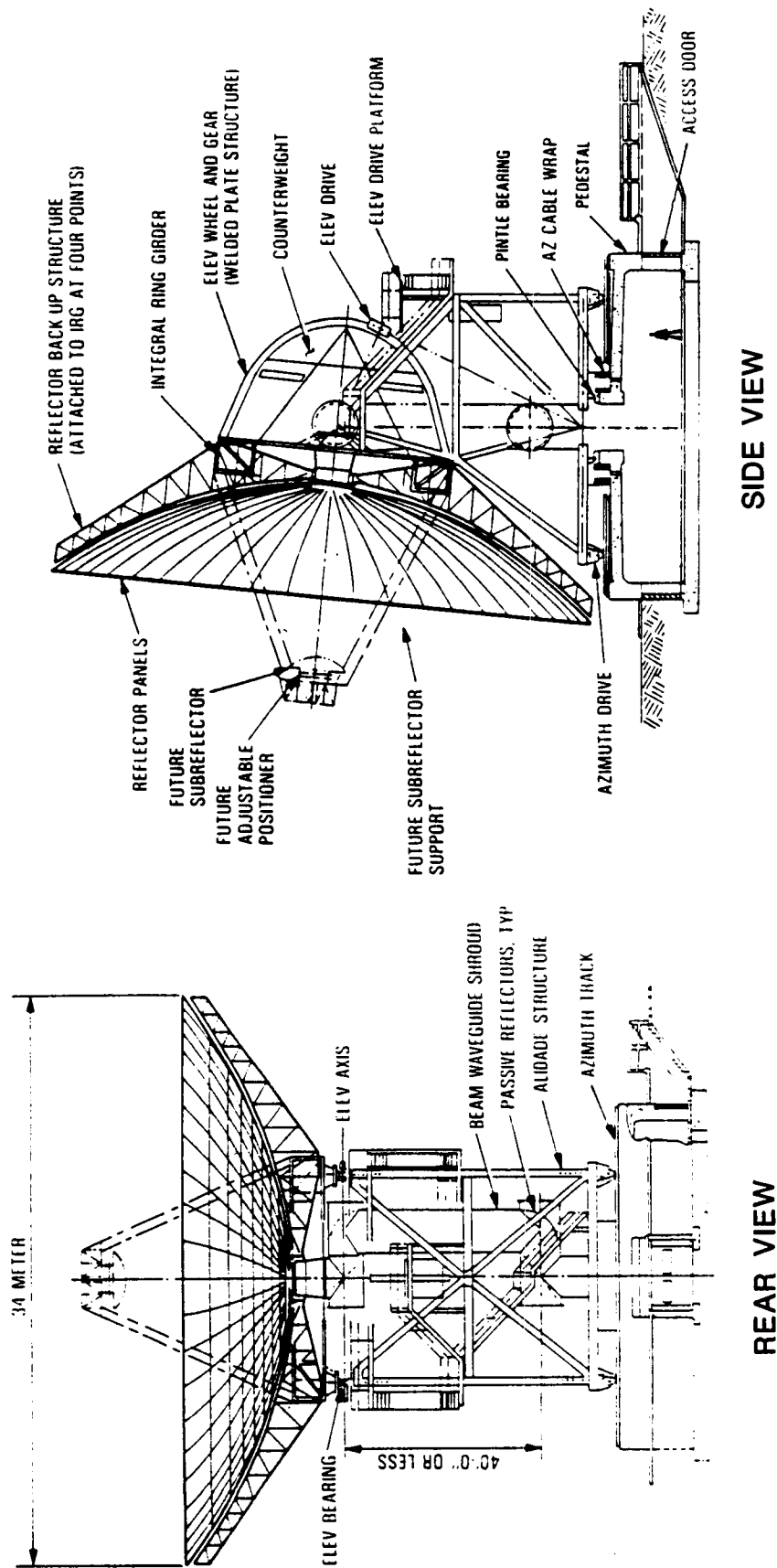


Figure 6. Artist's Drawing of the Proposed New 34-Meter Antenna at the Venus Site

## (5) City of Barstow

The city of Barstow's economic viability has been historically dependent on the railroad and trucking industries, tourism, and the military. Military influences include Fort Irwin, the Marine Corps Supply Depot, the Marine Corps Logistics Base, China Lake Naval Weapons Center, and Edwards Air Force Base. Future economic opportunities for the city of Barstow may lie with the tourism industry as travel increases between the Los Angeles region and Las Vegas.

### 2. Geologic Setting, Seismic Conditions, Lithology, Geologic History, and Soils

#### a. Geologic Setting

The GDSCC is located in the north central section of the Mojave Desert. The Mojave Desert Province consists of a wedge-shaped, down-faulted block bounded by mountain ranges to the north-northwest and south-southwest (Sharp, 1972). The structure and topography of the Province are largely fault controlled (Norris and Webb, 1976). The Mojave Desert is bounded on the south-southwest by the San Andreas Fault zone. The San Andreas Fault, which is the principal fault of a northwesterly trending shear zone, is at least 600 miles in length with 350 miles of right-lateral displacement. The Garlock Fault trends to the northwest and has left-lateral displacement.

The Mojave Desert Province is typified by broad, flat plains with occasional low mountains (1,000 to 2,000 ft). The Goldstone area is situated within one of these low mountain areas that trends in the northwest-southeast direction parallel to the regional structural trend. Elevations in the Goldstone area range from 2,895 to 4,491 ft above MSL. The GDSCC lies within a 70 square-mile internal drainage area that includes Goldstone Lake, the largest of several dry lakes in the area. The elevation of Goldstone Lake is 3,021 ft above MSL (Kieffer, 1961).

#### b. Seismic Conditions

The Mojave Block is broken by several major vertical to near-vertical shear faults. The primary fault system in the GDSCC area trends northwest, from the southern boundary of the Facility to the the southern tip of Goldstone Lake. This fault system which roughly parallels the San Andreas Fault zone follows the regional structural trend that is characteristic of that portion of the Mojave Desert Province south of the GDSCC. The Goldstone area is located in a transition zone between the northwest-trending area to the south, and an east-west-trending structural area to the north that roughly parallels the Garlock fault. Minor faults in the Goldstone area trend in nearly all directions, the main directions being west, northwest, and north.



The general relation between the two structural systems enclosing the Goldstone area are not known, but both systems are active, and neither predominates over the other.

The GDSCC is located within an area that has recently been reclassified from Zone 3 to Zone 4 seismic risk (Uniform Building Code, 1985, International Conference of Building Officials, Earthquake Regulations, Chapter 23). Zone 4 is defined as a zone susceptible to damage corresponding to a Modified Mercalli Scale Intensity VIII or greater earthquake. (The Mercalli Scale is an arbitrary scale of earthquake intensity, ranging from I for an earthquake detectable only with instruments, to XII for an earthquake resulting in total destruction).

Structures at the GDSCC would be exposed to considerable seismic shaking in the event of a major earthquake with potential for structural damage to occur at the site. The extent of impact would be a function of soil composition, design of the structures, and their joint response to seismic shaking. The GDSCC is in an area of seismic risk, considering the existing soil conditions and construction standards currently applied at the facility. For those structures constructed prior to the zone change, the GDSCC has implemented a program to upgrade older structures to meet the Zone 4 code, as applicable.

c. Lithology

Surficial geology at the GDSCC is shown in Figure 7. Table 8 is a stratigraphic sequence of the Mojave Desert Province in the Goldstone area that gives the maximum thickness and a brief lithologic description of each stratigraphic unit. It should be noted that this is a generalized sequence and that at any given site some of the units may or may not be present or may or may not be present in the given thickness. The general stratigraphic column in Table 8 was constructed from information obtained from Kieffer (1961).

d. Geologic History

The following is a brief summary of geologic events that occurred in the past in the Goldstone area (Kieffer, 1961):

- (1) The Granitic Complex crystallized during Precambrian or early Paleozoic time. These rocks underwent metamorphic recrystallization, and were later intruded (cut into) by granitic (pegmatite) dikes (thin injections of molten rock).
- (2) Sediments of the Rustic Formation were deposited and metamorphosed (recrystallized) during Late Paleozoic time.

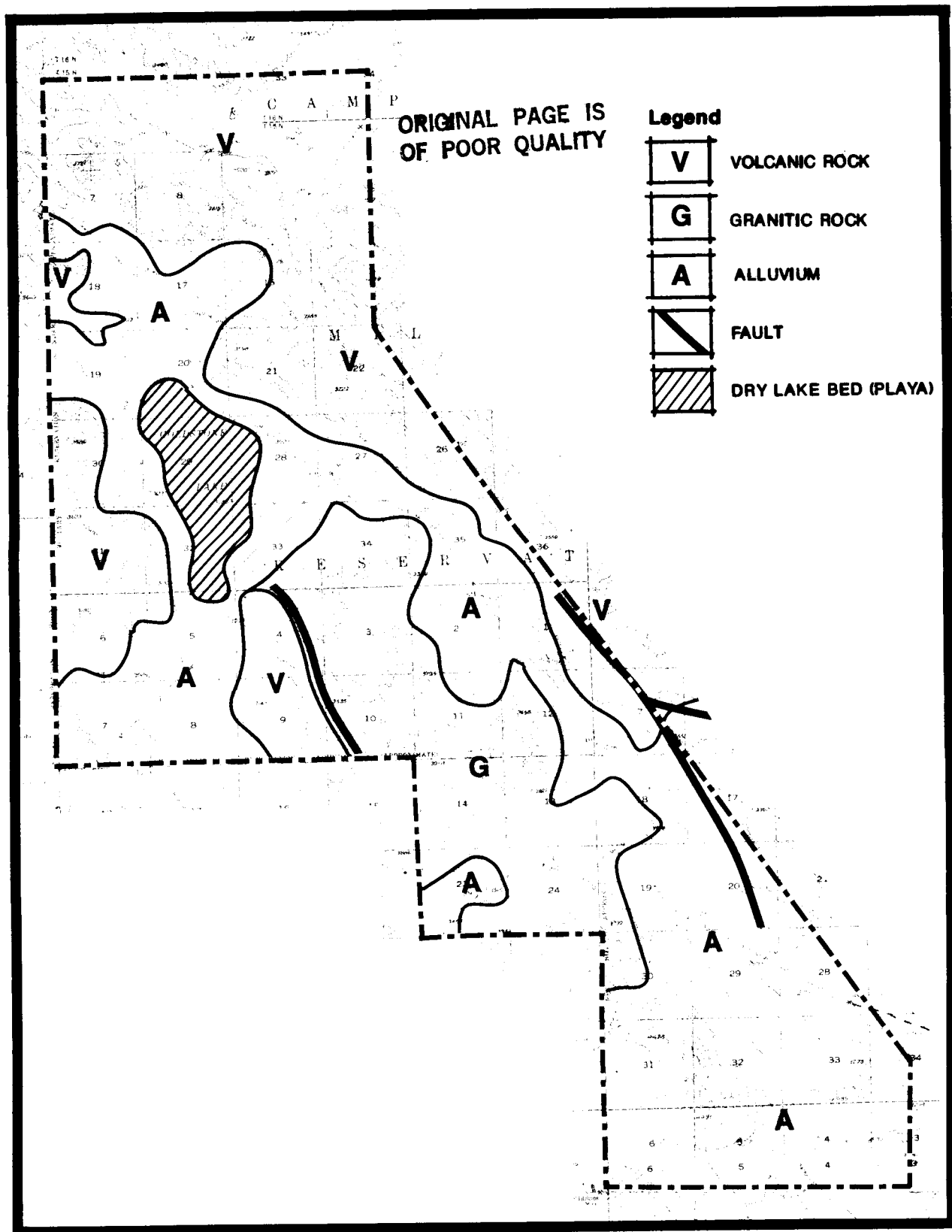


Figure 7. Depiction of Surficial Geological Features at the GDSCC

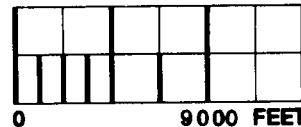


Table 8. Generalized Stratigraphic Sequence in the Goldstone Area  
(after Kieffer, 1961)

Series	Stratigraphic Unit	Maximum Thickness (ft)	Description
Quarternary (Pleistocene) <sup>a</sup>	Gravel Deposit	300+	Composed of cobbles and boulders of volcanic rocks; occurs in extreme northern part of area; alluvial fan deposit has been uplifted and moderately cemented in a caliche matrix.
Quarternary (Pleistocene) <sup>a</sup>	Basalt Flow	b	Vesicular olivine basalt; resistant to erosion, caps several ridges, dips gently north; offset by faults only in southeast of area.
Quarternary to Tertiary	Conglomeratic Sandstone	b	Overlies andesite southeast of Pink Canyon.
Quarternary to Tertiary	Black Glass Dikes	c	General trend N70E, intrude andesite flows only; assumed they occurred near end of andesite extrusion.
Tertiary	Andesite Flows	1000+	Thick sequence of lava flows; composed of andesite, hornblende andesite, and porphyritic plagioclase; flowed from several volcanic vents; very resistant.
Tertiary	Andesite Breccia	600+ (with tuff)	Angular blocks of volcanic rock set in a matrix of volcanic ash; coarse grained with large clasts, resistant to erosion; common caps rock.

Table 8 (Cont'd)

Series	Stratigraphic Unit	Maximum Thickness (ft)	Description
Tertiary	Andesite Tuff	600+ (with Breccia)	Volcanic ash; well bedded, soft, and nonresistant to erosion.
Cretaceous	Jack Spring Quartz Monzonite <sup>c</sup>		Quartz monzonite pluton which extends over 85 square miles; has an orthogonal fracture system, parallel jointing, very solid and homogeneous.
Paleozoic	Rustic Formation	<sup>b</sup>	Limestones and metamorphic rocks derived from fine-grained sediments; foliated, very hard, and moderately fractured, containing several quartz veins with gold and tungsten.
Paleozoic to Precambrian	Granitic Complex	<sup>c</sup>	Metamorphic and intrusive granitic rocks; schists and gneisses, highly shattered, low resistance to erosion.

<sup>a</sup> This unit is apparently of Pleistocene Age, but its exact age has not been confirmed.

<sup>b</sup> Thickness was undocumented in available source literature.

<sup>c</sup> Thickness cannot be determined for this type of rock body.

- (3) Magma (molten rock) of the Jack Spring Quartz Monzonite intruded the existing older rocks probably during Cretaceous time.
- (4) Uplift and erosion of the area occurred, and most Paleozoic and Precambrian rocks were eroded away.
- (5) A broad basin formed in Tertiary (Miocene) time. Volcanic fragments composed of andesite tuffs and breccias erupted as ash and covered the basin floor with a deposit 600 ft thick. Up to 1,000 ft of andesite lava flows originating from several volcanic vents covered the ash. Black glass dikes intruded the andesite flows.
- (6) Conglomeratic sandstone was deposited atop the andesite lava beds in places.
- (7) The region was uplifted and extensively faulted in Late Tertiary and Quarternary time.
- (8) Lava composed of olivine basalt partially covered the region. Since deposition, the basalt has been tilted slightly to the north and extensively faulted in the southern part of the region.
- (9) Quarternary alluvial deposits include the following: dry lake bed sediments; low lying sand and gravel alluvium in the main valleys; gravel and boulder alluvial fans and debris slope deposits; unconsolidated sand, gravel and boulders in stream channels; and windblown sand. Alluvium ranges from 500 to 1,000 ft in thickness.

e. Soils

The following three soil types predominate at the GDSCC:

- (1) Silty, sandy gravel derived from granitic rocks
- (2) Silty gravel derived from decomposing volcanic rocks
- (3) Very rocky soils derived from older, dissected alluvial deposits and terrace gravels.

Both the volcanic and granitic soils have medium to low permeability.

Desert pavement, also known as desert varnish, (a residual layer of large soil particles left on the ground surface after the finer particles have been carried off by wind and water) is developed over virtually all soil surfaces and is made up of gravels that protect the surface against further erosion. These lag gravels are often coated with oxides of iron and manganese that give the surface of the desert varnish its shiny appearance.

## E. BIOTIC RESOURCES

The descriptions of the biotic resources of the GDSCC follow from the information obtained through field reconnaissance, supplemented by information obtained from the existing literature. In May 1987, the GDSCC was surveyed by 4-wheel-drive vehicle and on foot by the MBGA project team. Weather at the time of the survey was warm, with temperatures ranging from 80 to 85°F, occasional thunderstorms, and moderately strong winds. Biotic resources were mapped in the field with the aid of U.S. Geological Survey 15-minute series topographic maps (Lane Mountain and Goldstone Lake).

Habitat designations are according to the classification system of Munz and Keck (1959) and Barbour and Major (1977). The floral taxonomy used follows the flora of M. DeDecker (1984) and the current checklist of Kartesz and Kartesz (1980). Common plant names, where not available from Munz (1974), are taken from Abrams (1923), Robbins, *et al.* (1951), Niehaus and Ripper (1976), and Jaeger (1941). Vertebrates identified in the field by sight, calls, tracks, scat, or other signs are cited according to the nomenclature of Jennings (1983) for reptiles; the American Ornithologists' Union (1983) for birds; and Jones, *et al.* (1982) for mammals.

### 1. Vegetation

The vegetation of the area is typical of the mid-elevation region of the Mojave Desert. Heat-tolerant, perennial shrub species, creosote bush scrub and saltbush scrub, dominate both of the major plant communities present on the complex. The general distribution of these two communities is shown in Figure 8.

#### a. Creosote Bush Scrub

The creosote bush scrub found on the complex represents the dominant plant community throughout the Mojave Desert. The community is commonly found on the flats, bajadas (alluvial plains formed at the base of a mountain by the coming together of several alluvial fans), steeper slopes and hilltops below an elevation of 4,000 ft. The dominant plant species of the creosote bush scrub are creosote bush (Larrea tridentata) and burro-weed (Ambrosia dumosa). Hop-sage (Grayia spinosa) and goldenhead (Acamptopappus sphaerocephalus) are examples of other common creosote bush scrub species. The visual aspect of this community is one of widely and uniformly spaced creosote bush shrubs with interspersed low, sparse ground cover. Plant cover is commonly as low as 10 to 20 percent of the area.

Although the creosote bush scrub superficially seems monotonously uniform, there may be significant local differences in species composition. Diversity increases with topographical diversity and is strongly affected by substrate. In areas such as sandy washes or rocky soil, which are relatively common at the GDSCC, the creosote brush scrub is present but not dominant. In the sandy washes, species such as Anderson thornbush (Lycium andersonii), bladder sage (Salazaria mexicana), senna (Cassia armata) and cheesebush (Hymenoclea salsola) are common. The rocky hillside association supports species such as desert trumpet (Eriogonum inflatum), winterfat (Eurotia lanata) and desert holly (Atriplex hymenelytra).

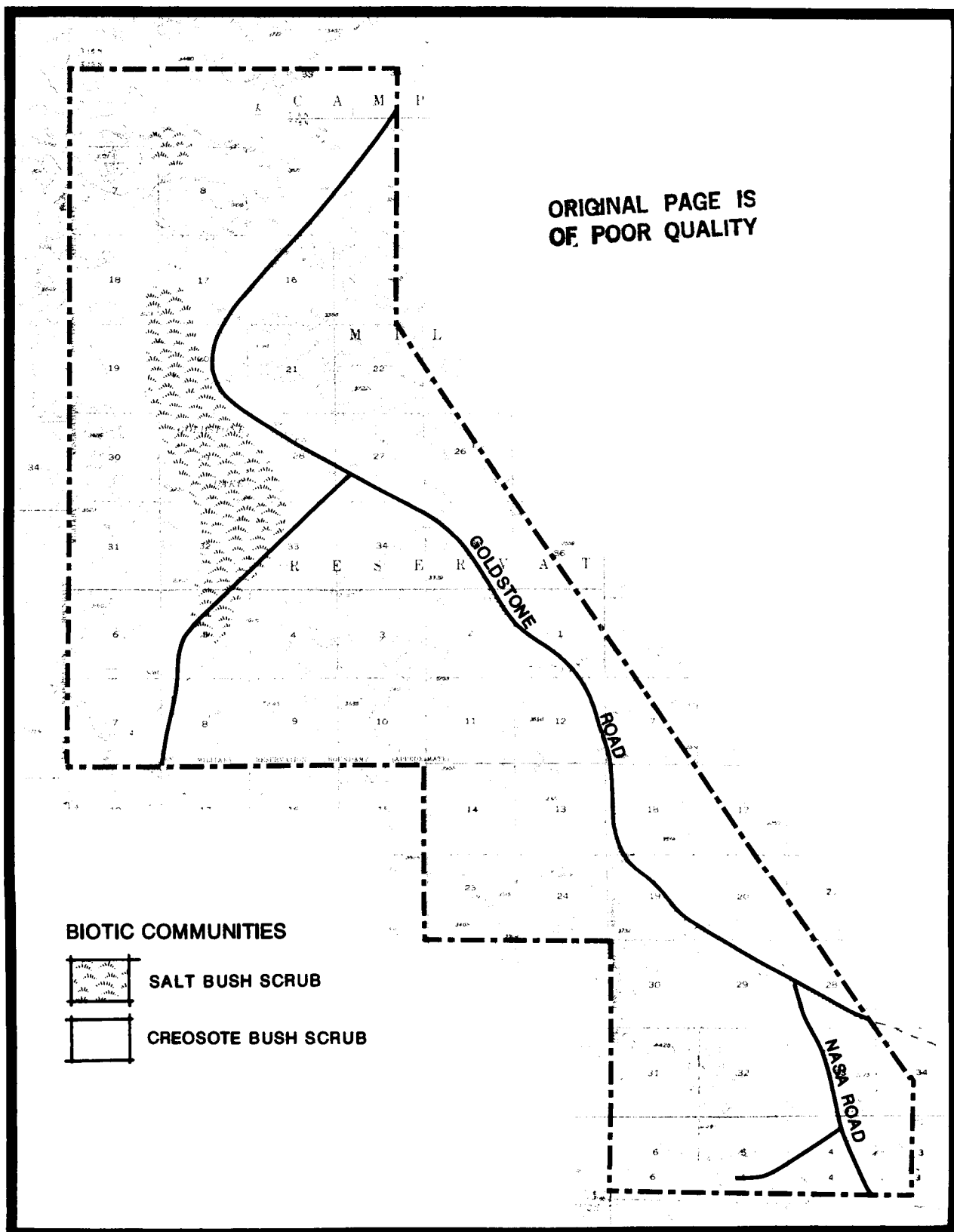


Figure 8. General Distribution of Two Scrub-Plant Communities at the GSDCC

Large areas where the dominant ground cover consists of introduced, annual grasses such as abu-mashi (Schismus arabicus) and red brome (Bromus rubens) and annual forbs, such as red-stemmed filaree (Erodium cicutarium) are also common within the creosote bush scrub community. These same open areas may support diverse displays of annual wildflowers, such as cryptantha (Cryptantha spp.), pebble pincushion (Chaenactis carphoclina), brown-eyed evening primrose (Camissonia claviformis), desert dandelion (Malacothrix glabrata), gilia (Gilia spp.) and desert aster (Machaeranthera tortifolia). Joshua trees (Yucca brevifolia) are an infrequent component of the creosote bush scrub community in the southern portion of the GDSCC.

#### b. Saltbush Scrub

The saltbush scrub community, often called the alkali sink community, is found on poorly drained alkaline flats and playas (dry lake beds) throughout the Mojave Desert region. On the GDSCC, saltbush scrub is found around Goldstone Lake and an unnamed dry lake at the northern end of the complex.

Typical species of the saltbush scrub community include plants that are very tolerant of high salt concentrations, such as saltbush (Atriplex canescens) and salt grass (Distichlis spicata). Further from the edges of the playa, where the soil is less alkaline, shrub species such as desert holly (Atriplex hymenelytra) grade into the creosote bush scrub community.

### 2. Wildlife

Based upon field observation and literature search, the wildlife expected to occur in the habitats of the GDSCC is described in the following sections. This expected wildlife, with a few noted exceptions, is common throughout the Mojave Desert, and on-going and planned activities at the GDSCC typically would not result in significant impact on these faunal resources.

#### a. Amphibians and Reptiles

Because of the absence of surface water at the GDSCC, no amphibians are expected. Several varieties of reptiles present in both the creosote bush and saltbush scrub, are expected to occur at the GDSCC. Common lizards including the western whiptail (Cnemidophorus tigris), zebra-tailed lizard (Callisaurus draconoides) and side-blotched lizard (Uta stansburiana) were observed during the field survey. Other reptile species expected to occur with some frequency throughout the creosote bush scrub community are desert iguana (Dipsosaurus dorsalis), desert horned lizard (Phrynosoma platyrhinos), common leopard lizard (Gambelia wislizenii), coachwhip (Masticophis flagellum) and sidewinder (Crotalus cerastes).

The desert tortoise (Gopherus agassizi), a state-listed threatened reptile species, has been reported to occur at the GDSCC (Kirtland 1987).



b. Birds

A number of bird species are expected to breed in the creosote bush scrub community found at the GDSCC. These include the black-throated sparrow (Amphispiza bilineata), Say's phoebe (Sayornis saya), Le Conte's thrasher (Toxostoma lecontei), mourning dove (Zenaidura macroura), loggerhead shrike (Lanius ludovicianus), and horned lark (Eremophila alpestris).

Four species of raptors may breed or forage on or in the vicinity of the GDSCC. Common barn owls (Tyto alba) nest in crevices and caves, that are found on several buttes within the complex. Red-tailed hawks (Buteo jamaicensis) may breed locally, although they are more frequently observed in this region during the winter. A prairie falcon pair (Falco mexicanus) was observed nesting in a cliff area on the northwestern edge of the complex during the present survey. This species is an uncommon breeding resident of the GDSCC. The golden eagle (Aquila chrysaetos) may also breed in the area, but generally does not forage over the low desert, preferring higher ground with more topographic relief.

c. Mammals

Small mammals are common in the Mojave Desert. Most of these are nocturnal. The long-tailed pocket mouse (Perognathus formosa), canyon mouse (Peromyscus crinitus) and desert wood rat (Neotoma lepida) are found in rocky terrain. The little pocket mouse (Perognathus longimembris) is common in washes. Merriam's kangaroo rat (Dipodomys merriami) is likely the most abundant and widespread small mammal within the GDSCC.

The Mojave ground squirrel (Spermophilus mohavensis), a diurnal species, is expected to be present in the area. The black-tailed jack rabbit (Lepus californicus) and desert cottontail (Sylvilagus audubonii) are common throughout the area.

Predators expected in the area include the coyote (Canis latrans), kit fox (Vulpes macrotis), ringtail (Bassariscus astutus) and bobcat (Felis rufus).

F. ENDANGERED SPECIES

Only species considered sensitive at the GDSCC or in the complex's vicinity are included in this discussion. These species have been given special recognition by Federal, state or local resource conservation agencies and organizations due to declining, limited or threatened populations. Sources used for determination of sensitive biological resources are as follows:

- (1) Wildlife - U.S. Fish and Wildlife Service (FWS) (1986), California Natural Diversity Data Base (CNDDB) (1987), California Department of Fish and Game (CDFG) (1980, 1986), Remsen (1978), Tate (1986), and Bureau of Land Management (BLM) (1980);
- (2) Plants - FWS (1986), CDFG (1985), CNDDB (1987), and Smith and York (1984).

## 1. Vegetation

No plant species listed as rare, threatened, or endangered by the state or Federal government are known or expected to occur at the GDSCC. At the GDSCC, however, appropriate habitats are found within the known range of nine plant species that are listed as sensitive by Federal or state agencies. The nine species are identified in Table 9. Only one of these species, the Mojave indigo bush, was observed during the May 1987 survey. It should be noted, however, that the scope of the survey did not include directed searches for particular plant species.

## 2. Wildlife

A number of sensitive species of animals is found in the vicinity of the GDSCC. Many of these species however, also are found in habitats that are not present at the GDSCC (e.g., Mojave chub species or desert bighorn sheep). Migratory bird species that are considered sensitive or endangered (bald eagle) occur only rarely as strays in the Mojave Desert. Others, especially birds on the National Audubon Society's (NAS) Blue List (Tate, 1986, American kestrel and loggerhead shrike) are considered sensitive due to declining populations in other parts of their range.

Five species of vertebrates designated as rare, threatened or endangered by FWS, CDFG, BLM or NAS have been found in appropriate habitats on or in the vicinity of the GDSCC. These are listed in Table 10. Of these, only one, the prairie falcon, was observed during the present survey.

The desert tortoise, although not observed during the present survey (through direct sighting or sign) is expected to occur at the GDSCC because the complex represents a suitable, undisturbed habitat within the known range for the species.

## G. WETLANDS AND FLOODPLAINS

### 1. Wetlands

There are no permanent sources of water at the GDSCC in the form of seeps, springs, streams, or lakes. Most of the buttes and bajadas found on the complex, however, are bisected by ephemeral washes that carry runoff from rain. Some storage of moisture occurs in the sandy soil of these washes. This provides an important mesic environment for many insects and annual plant species. These washes, therefore, are an essential part of the desert ecosystem.

Table 9. Sensitive Plant Species Potentially Occurring at the GDSCC

Species	Status <sup>a</sup>		Habitat
	FWS	CNPS	
<u>Androstephium breviflorum</u> Small-flowered androstephium	---	2 <sup>b</sup>	Gravelly to rocky soils below 7,000 ft.
<u>Astragalus jaegerianus</u> <sup>c</sup> Jaeger's Locoweed	C2 <sup>d</sup>	1B <sup>e</sup>	Sandy to gravelly soils below 4,000 ft. elevation
<u>Chorizanthe spinosa</u> Mohave spiny-herb	C2	4 <sup>f</sup>	Same
<u>Cymopterus deserticolus</u> desert cymopterus	C2	1B	Same
<u>Dudleya saxosa ssp. saxosa</u> Panamint dudleya	C2	4	Rocky, steep slopes
<u>Eriophyllum mohavense</u> Mojave eriophyllum	C2	1B	Sandy and gravelly soils below 4,000 ft. elevation
<u>Linanthus arenicola</u> Sand linanthus	C3 <sup>g</sup>	2	Deep sandy soils
<u>Psorothamus arborescens</u> var. <u>arborescens (Dalea a.)</u> <sup>c</sup> Mojave indigo bush	C3	4	Same
<u>Sclerocactus polyancistrus</u> Mojave fish-hook cactus	C2	4	Rocky soil

<sup>a</sup>Listing agencies/organizations: FWS - U.S. Fish and Wildlife Service; CNPS - California Native Plant Society. Species listed by the California Department of Fish and Game are not found in the GDSCC area.

<sup>b</sup>2 means rare and endangered in California, but more common elsewhere.

<sup>c</sup>Located during the May 1987 survey.

<sup>d</sup>C2 means Federal Category 2 candidate (decline of the species is suspected); Insufficient data exist, however, to support a proposed listing.

<sup>e</sup>1B means rare and endangered in California and elsewhere.

<sup>f</sup>4 means species has limited distribution.

<sup>g</sup>C3 means species is too widespread to warrant listing and/or not threatened.

Table 10. Sensitive Wildlife Species Located on or in the Vicinity of the GDSCC

Species	Status <sup>a</sup>				Habitat
	FWS	CDFG	BLM	NAS	
<u>Gopherus agassizii</u> desert tortoise	C1 <sup>b</sup>	--	SC <sup>c</sup>	--	Cresote bush scrub
<u>Aquila chrysaetos</u> golden eagle	--	SC3 <sup>d</sup>	PS <sup>e</sup>	--	Nests in cliffs, forages over creosote bush scrub
<u>Falco mexicanus</u> <sup>f</sup> prairie falcon	--	C3	--	--	Same
<u>Athene cunicularia</u> burrowing owl	--	SC2 <sup>g</sup>	--	2 <sup>h</sup>	Nests in banks of washes
<u>Spermophilus mohavensis</u> Mojave ground squirrel	--	Ti	--	--	Creosote bush scrub

<sup>a</sup>Listing agencies:

FWS - U.S. Fish and Wildlife Service;  
 CDFG - California Department of Fish and Game;  
 BLM - Bureau of Land Management;  
 NAS - National Audubon Society.

<sup>b</sup>C1 means Federal Category 1 candidate. Sufficient data exist to propose species for listing as threatened or endangered.

<sup>c</sup>S means BLM considers this species to be sensitive due to small population size, limited distribution, or threat from human activity.

<sup>d</sup>SC3 means State Species of Concern, List 3 (species not in immediate danger of extirpation). Small population sizes, however, warrant observation.

<sup>e</sup>PS means BLM proposed sensitive species, pending accumulation of sufficient data to support concern.

<sup>f</sup>Located during the May 1987 survey.

<sup>g</sup>SC2 means State Species of Concern, List 2 (species warrants active monitoring due to population decline).

<sup>h</sup>2 means NAS second priority species (2) (Special concern due to observed decline in population).

<sup>i</sup>T means listed by State as threatened.

Two playas, or dry lakes, also are found on the complex (Goldstone Lake and an unnamed lake in the northern portion of the complex near the Mars Site). These playas catch and hold both rainfall and runoff and may remain visibly damp for several weeks after a storm. Their soils usually are alkaline and wildlife use of these areas is somewhat restricted due to the high salt content of the playa vegetation.

## 2. Floodplains

The Federal Emergency Management Agency (FEMA) has not mapped floodplains for the Fort Irwin Military Reservation, including the area of the GDSCC. Approximately 90 percent of the land area in the southeast desert of California is classified as Zone D, an area of undetermined but possible flood hazard.

## H. SOLID WASTE GENERATION, TREATMENT, STORAGE AND DISPOSAL

The GDSCC operates one 10-acre, Class III solid waste landfill located at the Echo Site. The landfill is properly permitted and is being expanded to provide a projected remaining life of five years. The expansion effort is proceeding in accordance with prevailing regulations. Only non-putrescible, non-liquid, non-hazardous solid wastes are accepted for burial.

## I. TOXIC SUBSTANCES AND HAZARDOUS WASTE

The GDSCC neither stores nor uses large quantities of toxic or hazardous substances. The substances used in greatest quantities are fuels and oils. Purchases of drummed liquids are kept to a minimum. The GDSCC operates one main drum storage area at the Apollo site. This facility consists of drums stored on locked, metallic dispensing racks situated on a concrete pad. The facility is properly equipped with warning signs, fire extinguishers, and materials for spill cleanup. Small quantities of substances in containers are stored throughout the complex in a manner consistent with procedures established by the GDSCC Environmental Office. Storage locations are inspected on a routine basis. Typically, only the quantity of material needed to support operations is distributed for storage at each workplace.

Bulk products (primarily fuels and oil) are stored in permitted underground tanks in conformance with prevailing underground tank regulations. There are currently 27 underground tanks at the GDSCC, of which 15 now are used for storage of bulk fuels and oil. These 15 operative underground tanks are monitored daily for leakage. The 12 underground tanks that are not in use have been steam cleaned, inerted, and sealed (see JPL Publication 87-4, Volume 2, Underground Storage Tanks Compliance Program (June 15, 1987)).

Hazardous waste generated at the GDSCC is collected in drums at designated accumulation points throughout the complex. These accumulation points are maintained in conformance with procedures established by the GDSCC Environmental Office, and are inspected on a routine basis. Waste is transported from each accumulation point to a central staging facility located

at the Echo site. At this facility, all hazardous waste containers are readied for off-site transport to a commercial, permitted Hazardous Waste Management Facility for treatment, recycle, or disposal, as appropriate. GDSCC policy requires minimizing waste generation and supports detoxifying, reclamation, and reuse in preference to disposal.

#### J. PESTICIDES

The GDSCC does not directly purchase, store, or use pesticides. All pesticide application is by a licensed contract firm that brings spray applicators containing pre-mixed pesticide to the complex, applies the pesticide under the direction of the complex's Environmental Officer, and leaves the premises with all remaining product and spent canisters. Virtually all pesticide application is to the interior of buildings. In the event that it is necessary to spray outside areas prior to initiating new construction, Natural Resource Management personnel from Fort Irwin or from the private sector are consulted to ensure that spraying will not impact environmental resources.

#### K. RADIOACTIVE MATERIALS AND NONIONIZING RADIATION

The GDSCC uses no radioactive materials in its operations. It does operate, however, several large, high-powered microwave ground transmitters used in deep space communications. These transmitters are capable of transmitting radiation ranging from 10 kW to 500 kW of power. Transmission in this range produces radiation potentially hazardous to persons working nearby. The power density in the direct beam may cause severe biological damage, and the energy density in the feeding system is considered potentially lethal. Currently, DSS-14 (Mars Station) is the only GDSCC antenna station that radiates high-power on a routine basis.

JPL has issued Safety Practice Bulletin 12-4-6 that sets standards for safely operating antennas during transmissions. The bulletin addresses exposure hazards, exposure limits, and procedures for ensuring that all safety precautions are taken prior to and during a transmission event. In addition, the bulletin contains a requirement that JPL Form 0284-S, A Safety Review of New Operation, be completed prior to modification of an existing antenna or construction of a new radio frequency transmitter (see Appendix C).

High-power microwave transmissions also can generate effects at greater distances, potentially exposing aircraft to radiation. Procedures have been established with neighboring military installations and the Federal Aviation Administration (FAA) to prevent exposure of aircraft to radiation levels greater than 10 mW/cm. These procedures include restricting the permissible angles of radiation and avoiding the supersonic corridor, establishing a prearranged schedule for transmissions, and providing airspace avoidance contour plots to cognizant external agencies. The GDSCC has maintained a record of safe transmissions since it began operations.

## L. NOISE

The GDSCC noise environment is typical of quiet desert locations. The sparsely developed complex and restricted airspace, which minimizes interference with communications, promotes a quiet environment.

On-site noise sources include surface traffic, aircraft operations, and activities at each of the antenna sites. The GDSCC surface traffic and its associated noise level are relatively low with an on-site staff of only 217 and the extensive use of carpools. Fort Irwin military personnel frequently, however, cross the GDSCC to gain access to the China Lake Naval Weapons Center. The existing airport at Goldstone Dry Lake has scheduled operations by a twin-engine turboprop airplane operated by JPL/NASA. The U.S. Army also uses the airport for occasional landings. Since the airport is located a substantial distance from any site (see Figure 3), aircraft operations do not result in significant noise impacts. Equipment at each of the stations and other major facilities also contributes to the overall noise environment. But, even the loudest of hydromechanical equipment, generators, and pumps results in a highly localized noise level that does not extend more than a few hundred feet from each facility.

The GDSCC also is subject to noise generated by off-site sources that include ground military training exercises conducted by Fort Irwin, and air operations from a number of military installations. Fort Irwin noise impacts are attributed to ground maneuvers by Army tactical vehicles including heavy vehicles and tanks, weapon firing, and transportation of equipment adjacent to and through the GDSCC during and after maneuvers. Air operation noise impacts to the GDSCC derive from air-to-ground gunnery exercises, helicopter training, and supersonic activities. With a supersonic air corridor covering the southern section of Fort Irwin, sonic booms occasionally affect the GDSCC.

Because of its remote location and minimal noise-generating activities, the GDSCC does not impact on-site or off-site land uses. The complex, however, is subject to some noise disturbance by Fort Irwin military training exercises.

## M. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL FACTORS

Fort Irwin, including the GDSCC, is the location of numerous important prehistoric and historic archaeological sites. Army personnel, recognizing the value of these resources, have taken steps to improve their protection. Most significantly, the U.S. Army is party to a (nonbinding) Memorandum of Agreement with the California Historic Preservation Office and the Advisory Council on Historic Preservation that declares the intent of Fort Irwin to fund a program of restoration for archaeological sites. Fort Irwin employs a resident archaeologist to document sensitive resource areas within the Fort Irwin boundary, including the GDSCC.

Archaeologic resources in the region generally consist of open habitation, rock shelter, and quarry sites, all with a strong potential for the existence of petroglyphs, trails, rock alignments, etc. Some known sites

include lithic assemblages thought to be older than 10,000 years. The artifacts typically found consist of choppers, flake scrapers and bifacially-flaked "coup-de-point-like" implements similar to those of the Old World lower paeolithic period. Because access to Fort Irwin and the GDSCC is controlled, only a few archaeological sites, however, have been discovered and recorded. Many of the records of sites in the region are believed to satisfy the criteria for inclusion in the National Register of Historic Places, the State of California Listing of Historic Places, or the state's Points of Historic Interest. Areas with known sensitive archaeological or historic resources are fenced off and are identified by signs with posted warnings of trespassing penalties (Department of the Army, 1979).

Sensitive archaeologic and historic resources within the GDSCC are primarily localized in the northern and southeastern portions of the complex as shown in Figure 9. Both the Mars and Apollo Sites are in the vicinity of areas of archaeologic and/or historic interest. Documented areas with "surface scatter" and evidence of "historic battle" are also located within the GDSCC, on the eastern border adjacent to Fort Irwin and east of Echo Station and the Microwave Test Facility (Department of the Army, 1979).

Although documented sensitive resources are located near developed areas at the GDSCC, mitigation measures were incorporated during the planning stages to reduce potential impacts to those resources. Prior to any development at the GDSCC, Fort Irwin's resident archaeologist reviews the plans and recommends appropriate mitigation measures.

#### N. ECONOMIC, POPULATION AND EMPLOYMENT FACTORS

##### 1. Labor Force

Approximately 217 persons are employed at the GDSCC, with an additional 65 persons employed at the Barstow facility 45 miles from the complex. Most of these employees live in the Barstow area (Alderson, 1987). Labor categories consist primarily of technicians and engineers distributed among the various sites. The distribution of 282 employees within each labor category is provided in Table 11.

The 1985 labor force in the city of Barstow was approximately 10,533 or 53 percent of the 1985 population of 19,700. The entire GDSCC employment is approximately equivalent to 2.7 percent of the city of Barstow's labor force (assuming that the Barstow labor force has not significantly changed between 1985 and 1987). Normal fluctuations in employment levels at the GDSCC would be expected to have little impact on the local economy.



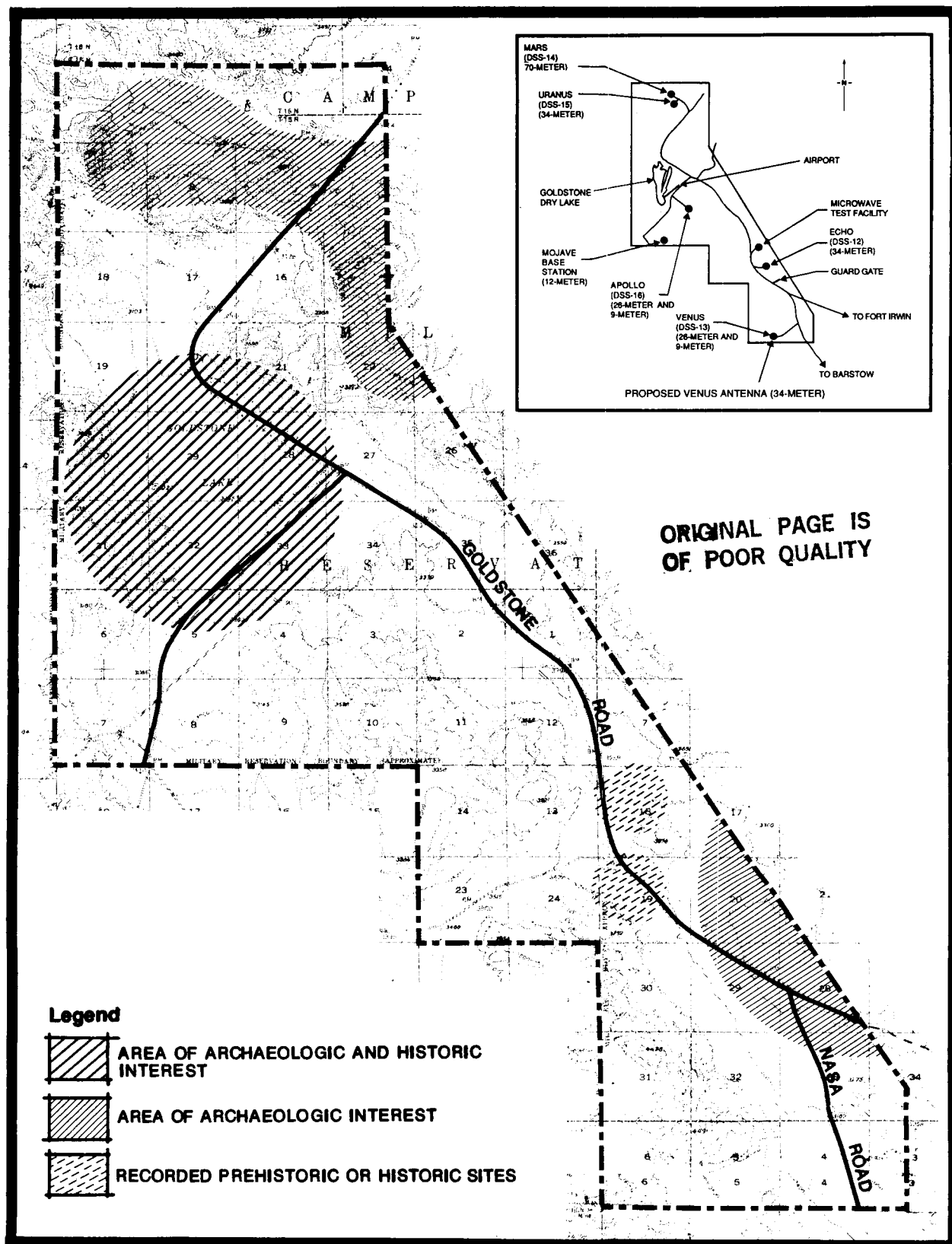


Figure 9. Sensitive Archeological and Historic Resources within the GSDCC

Table 11. Distribution of GDSCC Employees by Labor Category at Each Site (1987 Data).

Location	Labor Category	Number of Employees
Barstow Facility	Electronic Technicians	27
	Logistics Clerks	8
	Computer Programmers	4
	Administrative Staff	12
	Clerical	14
		<hr/> 65
GDSCC, DSS-12, Echo	Facility Staff - All Trades	52
	Operations Maintenance Technicians	27
	Administrative Staff	13
	Clerical	5
		<hr/> 97
GDSCC, DSS-13, Venus	Electronic Engineers	12
GDSCC, DSS-14, Mars	Operations Technicians	24
	Supervisors	12
	Antenna Technicians	12
		<hr/> 48
GDSCC, DSS-16 Apollo	Operations Technicians	24
	Supervisors	8
	Antenna Technicians	10
		<hr/> 42
Mojave Base Station	Engineers (NOAA)	18
		<hr/> 282

Source: Communication with John T. Macomber, Bendix Aerospace, Employee Relations, September 2, 1987.

## 2. Police and Fire Protection

The GDSCC maintains both a fire brigade and security guard patrol. The fire brigade consists of two full-time employees and 10 volunteer firemen available in the event of a significant emergency. The department has two fire trucks, one emergency vehicle, and one ambulance. The GDSCC has 12 security guards using two 4-wheeled vehicles for security operations (Alderson, 1987).

In addition to these on-site resources, the GDSCC has a working agreement with neighboring Fort Irwin for provision of fire and police protection when additional assistance is required. Fort Irwin has implemented an emergency telephone system to facilitate communication between the two installations. Emergency medical attention for GDSCC employees also is provided by Fort Irwin, which operates a full-service hospital. Immediate medical emergencies are treated at the GDSCC.

## 3. Transportation

The majority of employees at the GDSCC commute from the city of Barstow, located 45 miles south of the complex. Daily trips between Barstow and the GDSCC are primarily concentrated on Barstow and Fort Irwin Roads, to NASA Road and Goldstone Road. There are approximately 44 van pools, each operating a single round trip daily. These van pools transport a majority of the 217 on-site employees (Roberts, 1987).

SECTION IV  
CERTIFICATION

I hereby certify that all work performed by M. B. Gilbert Associates, Long Beach, California, in its preparation of this Environmental Resources Document that identifies the various environmental resources at the Goldstone Complex of the Ft. Irwin Military Reservation, San Bernardino, County, California, was performed in compliance with Federal, state, and local regulations, and in accordance with good engineering and investigative practice.

Leonard H. Kushner  
Registered Professional Engineer

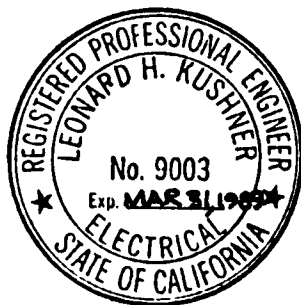
Signature Leonard H. Kushner

Date Signed: Sept 15, 1988

Registration No. E9003, Electrical  
SF1086, Safety

State: California  
California

Stamp/Seal



**APPENDIX A**

**LIST OF INDIVIDUALS AND AGENCIES CONTACTED AND INVOLVED  
IN PREPARATION OF THE GDSCC ENVIRONMENTAL  
RESOURCES DOCUMENT**

LIST OF INDIVIDUALS AND AGENCIES CONTACTED IN PREPARATION OF  
THE GDSCC ENVIRONMENTAL RESOURCES DOCUMENT

Alderson, Harold. Allied Bendix Aerospace. GDSCC Environmental Compliance Coordinator, 1987.

Fryell, Chuck. San Bernardino County, Air Pollution Control District. Telephone conversation on May 22, 1987.

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Turner, Keith. Lahontan Region, California Regional Water Quality Control Board. Telephone conversation on August 11, 1987.

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LIST OF INDIVIDUALS AND AGENCIES INVOLVED IN PREPARATION OF  
THE GDSCC ENVIRONMENTAL RESOURCES DOCUMENT

(1) Jet Propulsion Laboratory, California Institute of Technology

Office of Telecommunications and Data Acquisition

Leonard H. Kushner, P.E., TDA Safety and Environmental  
Compliance Engineer.

Glen G. Kroll, Cognizant Safety and Environmental Compliance  
Engineer.

Documentation Section 648:

Irving S. Bengelsdorf, Technical Writer/Specialist

(2) M.B. Gilbert Associates (Contractor)

Marsha Beck Gilbert, Principal-in-Charge

Marcia R. Baverman, Staff Engineer

Eva A. Hett, Senior Scientist

Cameron D. Toyne, Staff Geologist

Curtis E. Alling, American Institute of Certified Planners (AICP);  
NEPA Environmental Specialist, Consultant

Thomas W. Fitzwater, AICP; Environmental Issues, Consultant

Ellen Miille, Human Resources, Consultant

Karen Swirsky, Biologist, Consultant

Julie McCall, Environmental Scientist, Consultant

**APPENDIX B**  
**ENVIRONMENTAL RESOURCES: BIBLIOGRAPHY**



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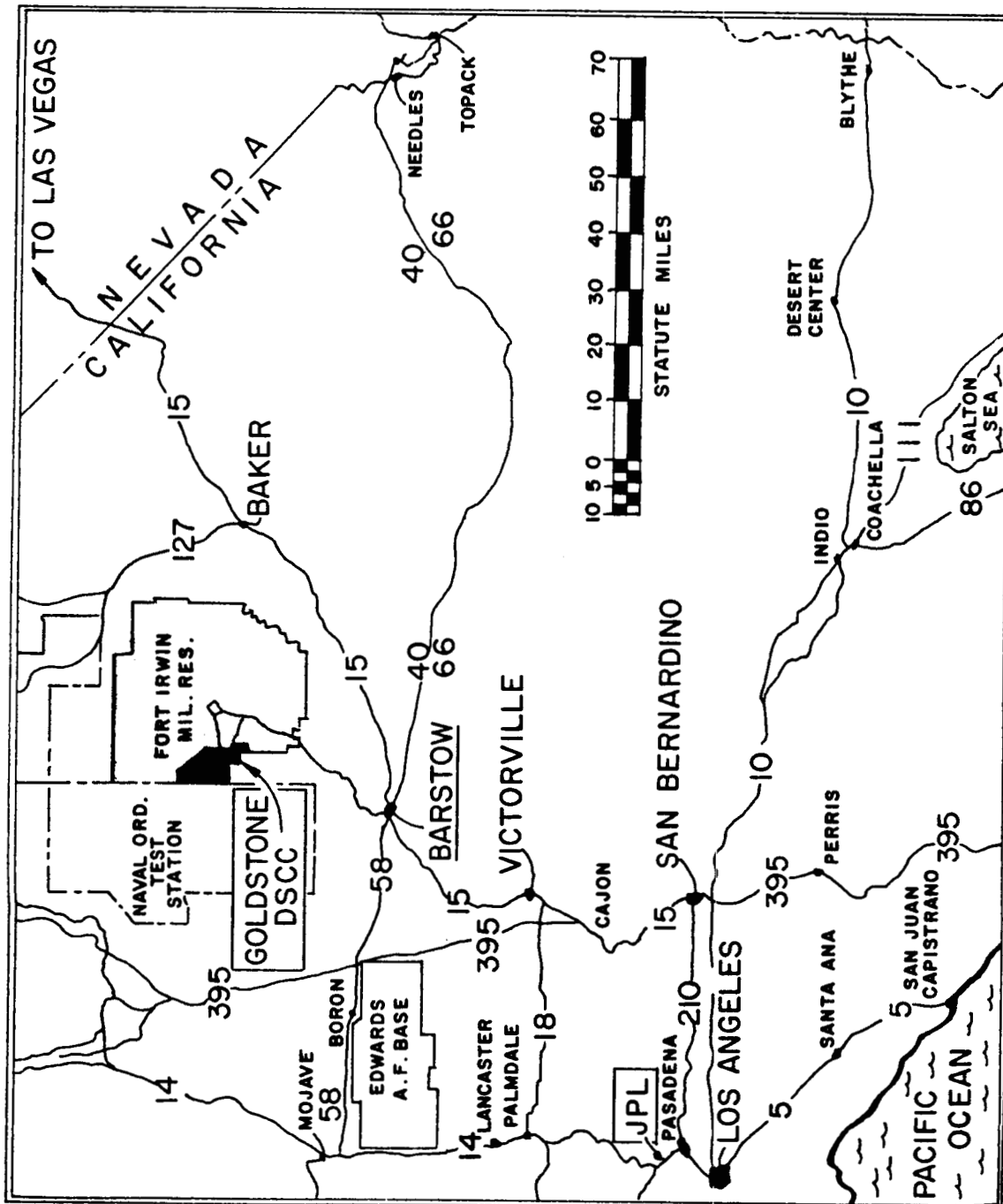
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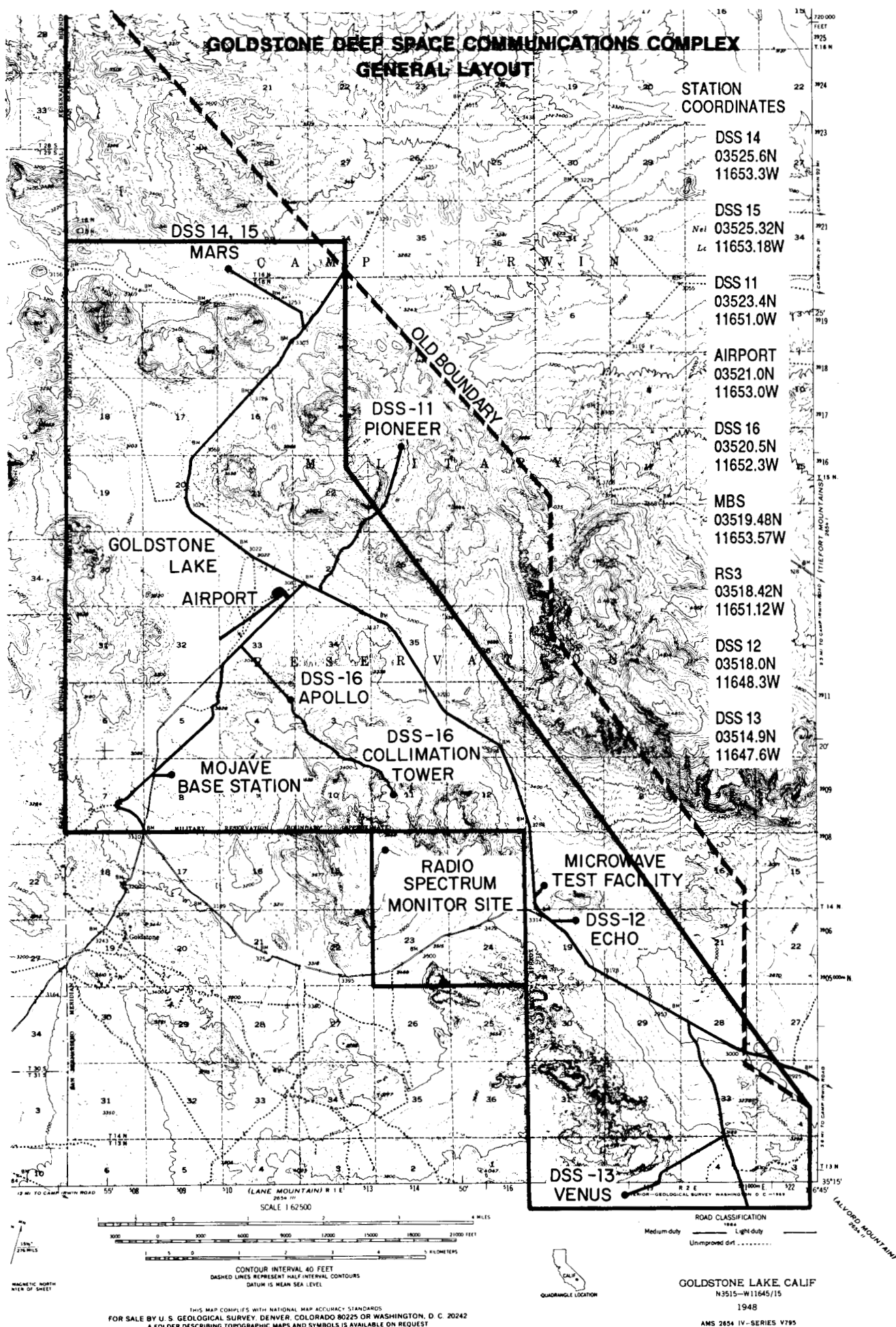
## **APPENDIX C**

**A GROUP OF 29 SELECTED ILLUSTRATIONS THAT DEPICT SOME  
OF THE INFRASTRUCTURE AND VARIOUS ASPECTS OF THE  
PHYSICAL AND GEOLOGICAL ENVIRONMENTS AT THE GDSCC**

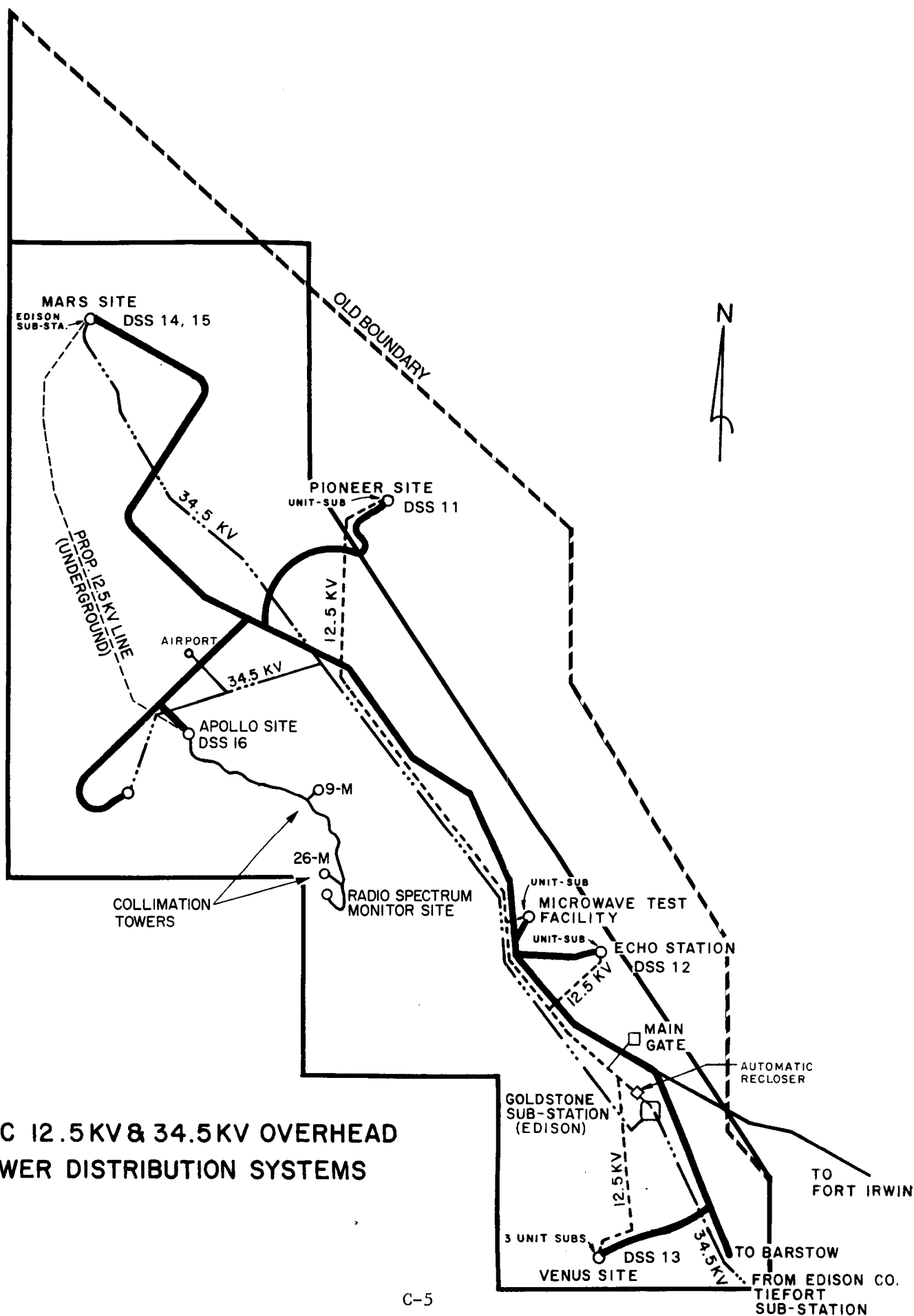


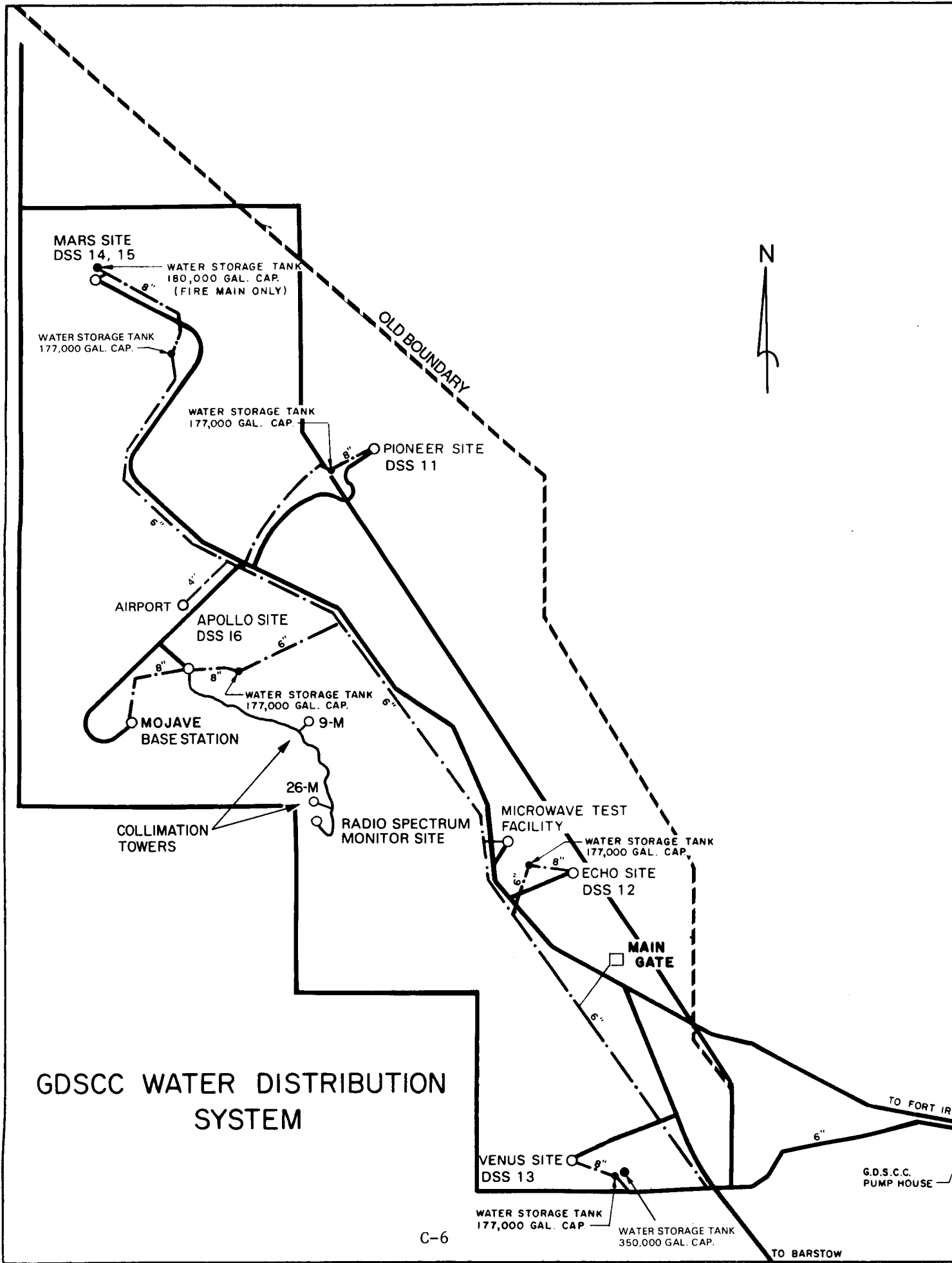
Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

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# **GDSCC 12.5 KV & 34.5 KV OVERHEAD POWER DISTRIBUTION SYSTEMS**





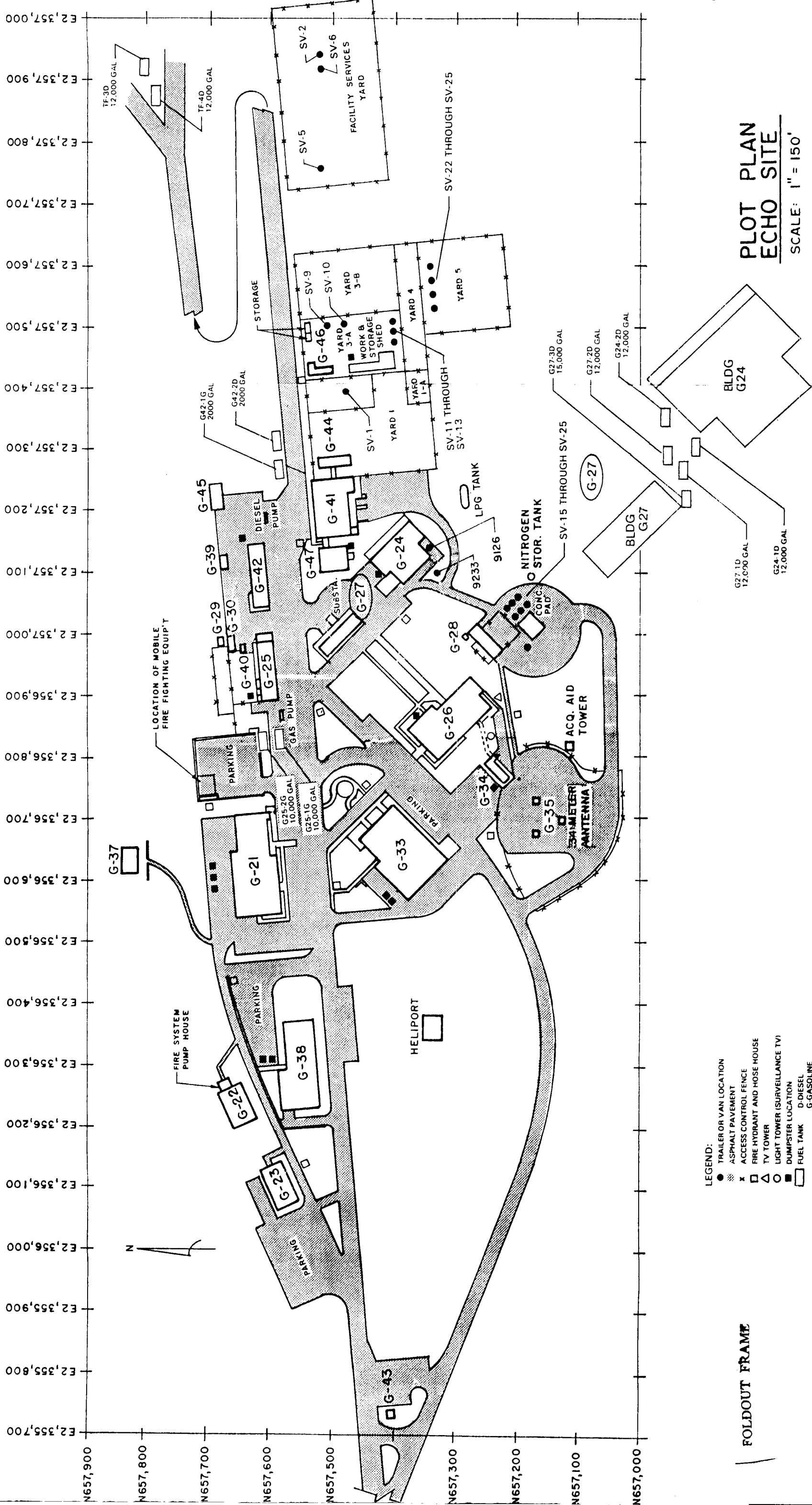
# GDSCC WATER DISTRIBUTION SYSTEM





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PLOT PLAN  
ECHO SITE

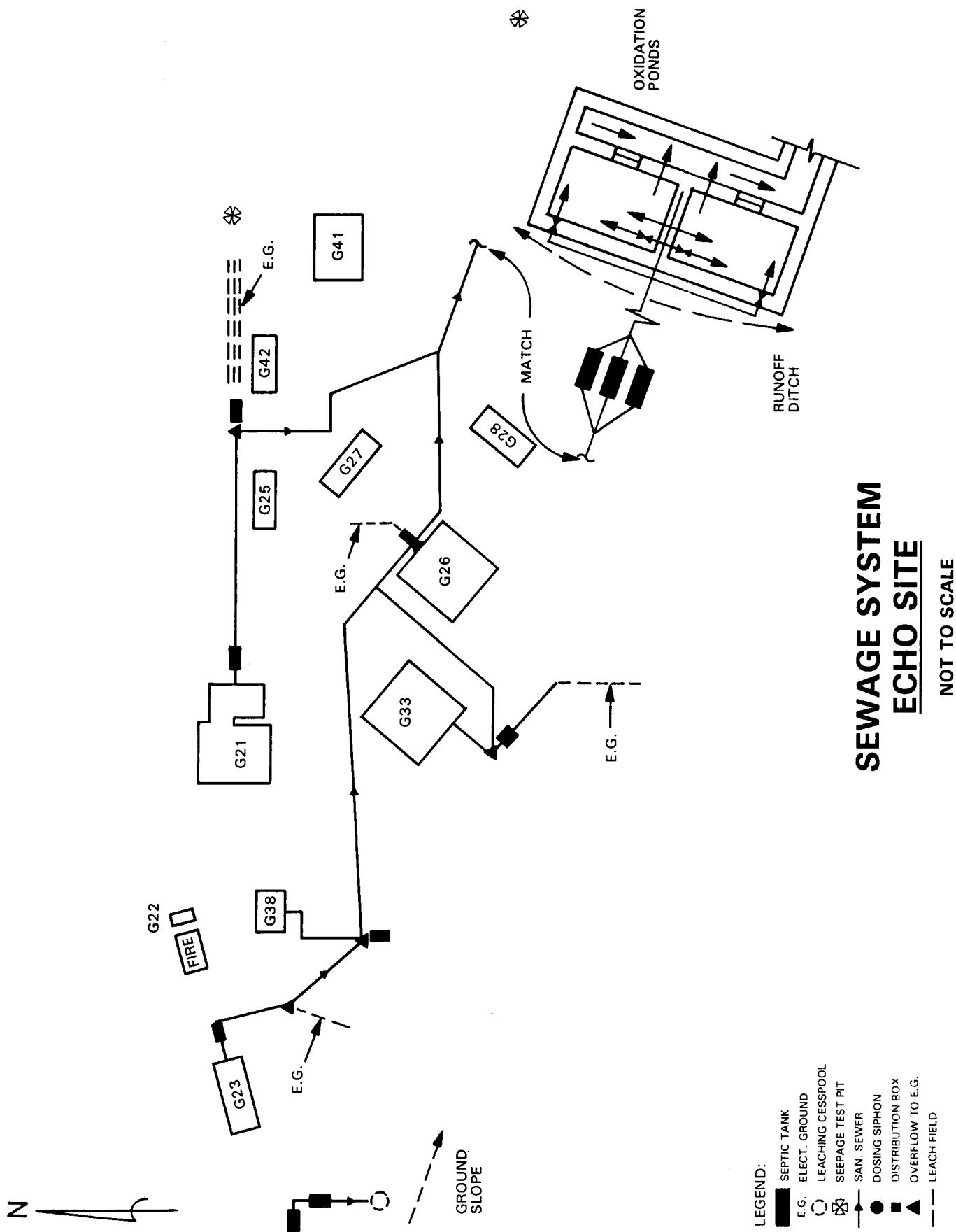
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C-9

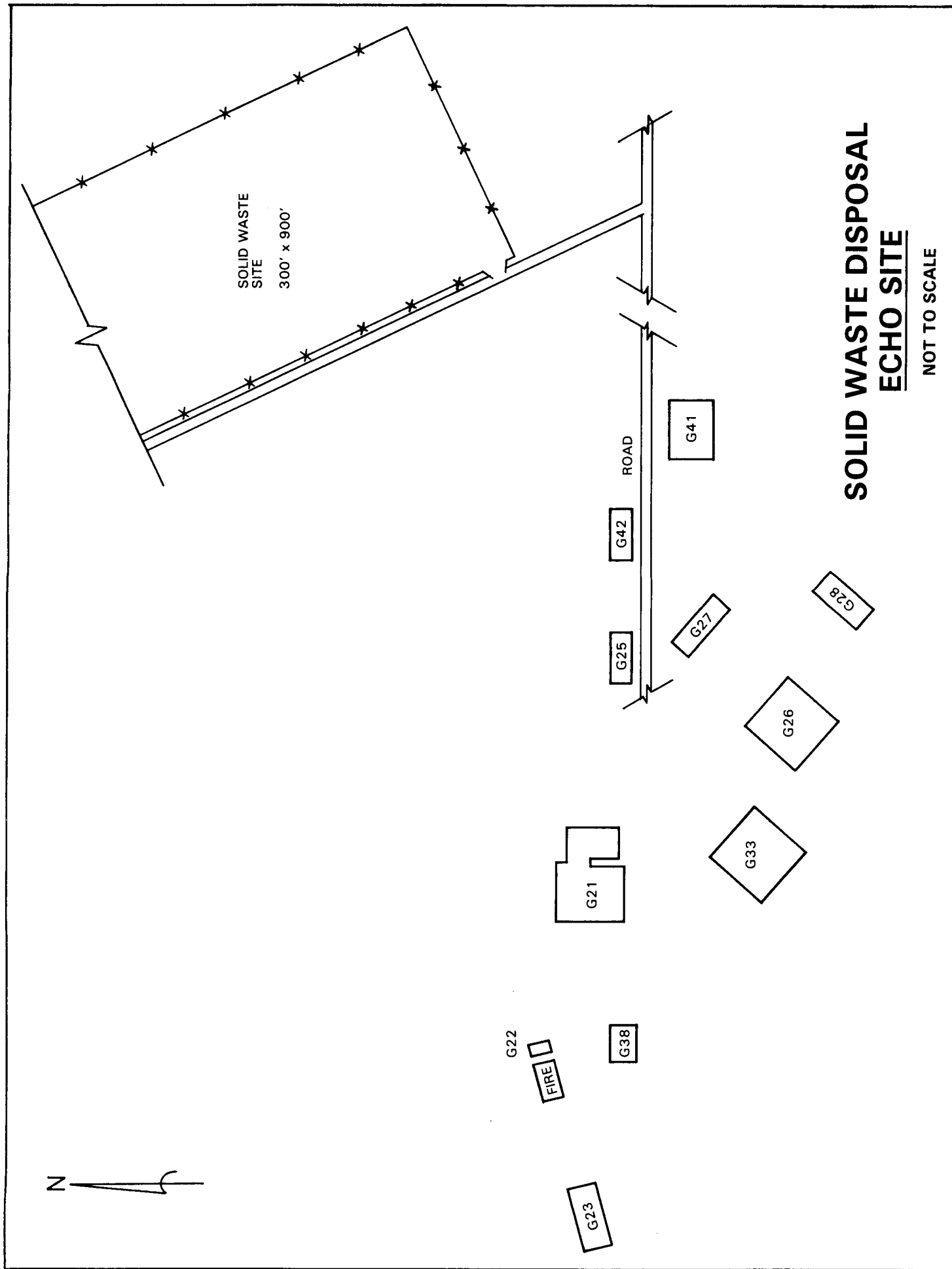
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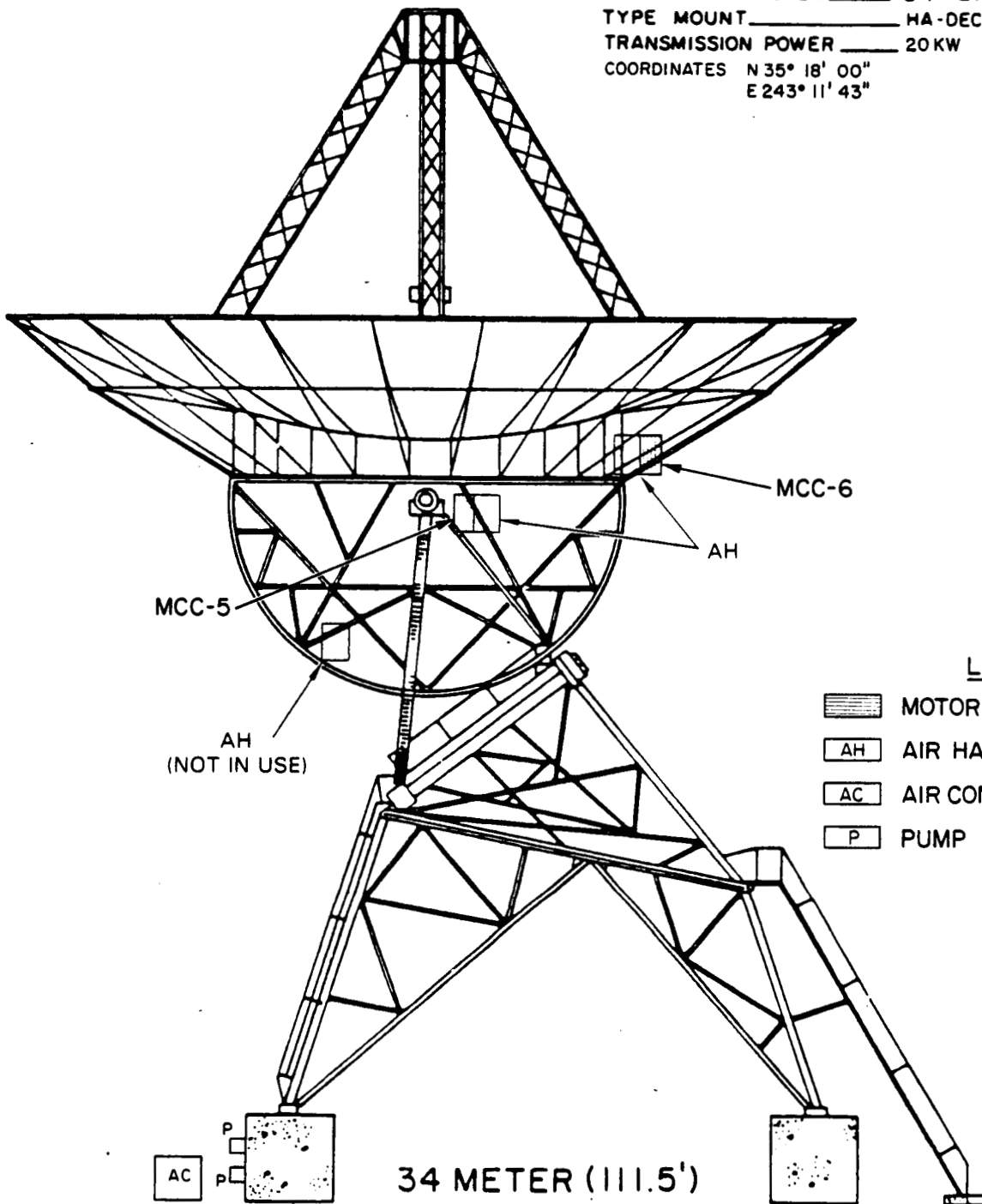
# SOLID WASTE DISPOSAL ECHO SITE

NOT TO SCALE







ANTENNA DATA:

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 TRANSMISSION POWER \_\_\_\_\_ 20 KW  
 COORDINATES N 35° 18' 00"  
 E 243° 11' 43"

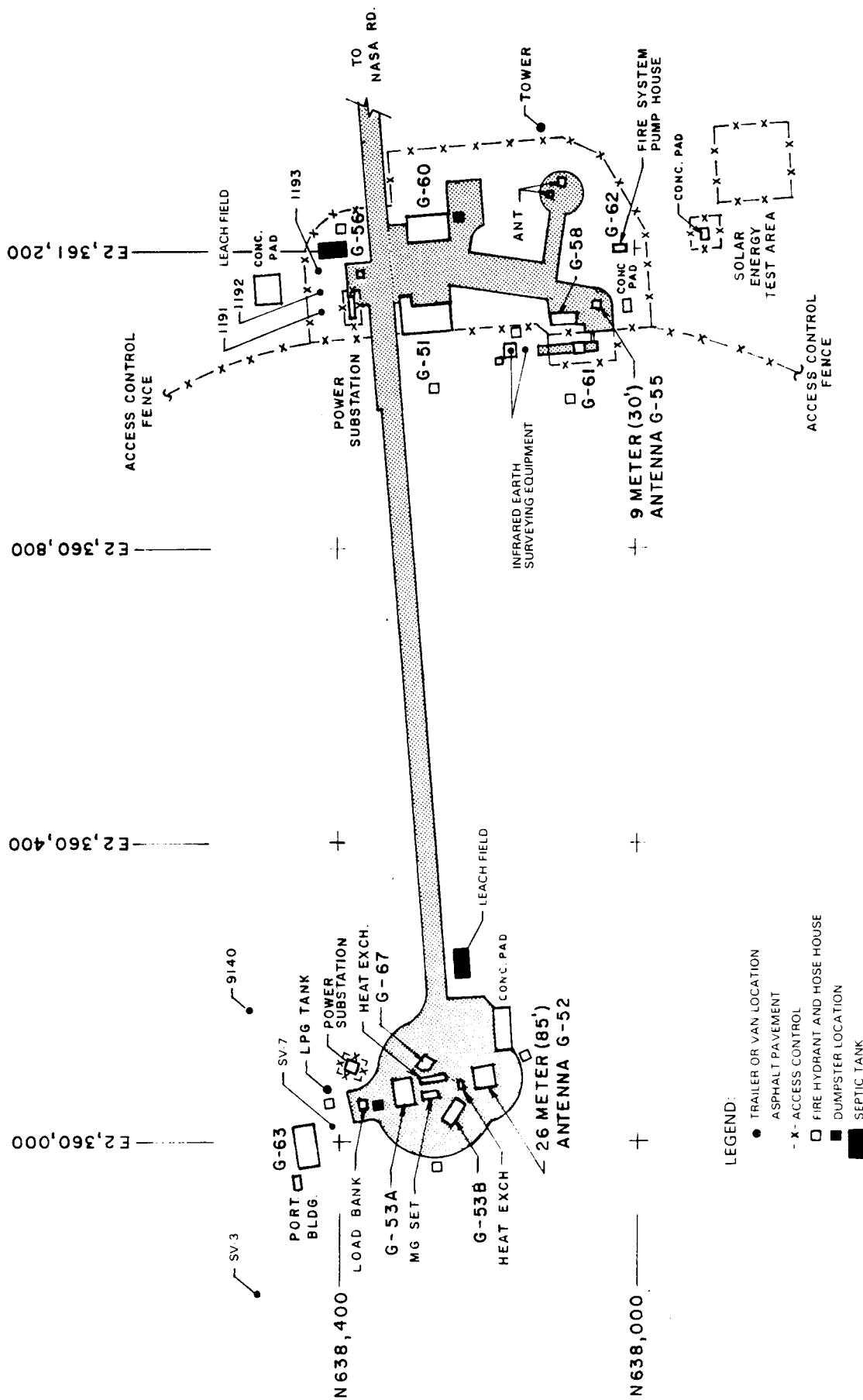


LEGEND

-  MOTOR CONTROL CENTER
-  AIR HANDLER
-  AIR CONDITIONER
-  PUMP

34 METER (111.5')  
 ANTENNA, BLDG. G-35  
 ECHO STATION

SCALE NONE

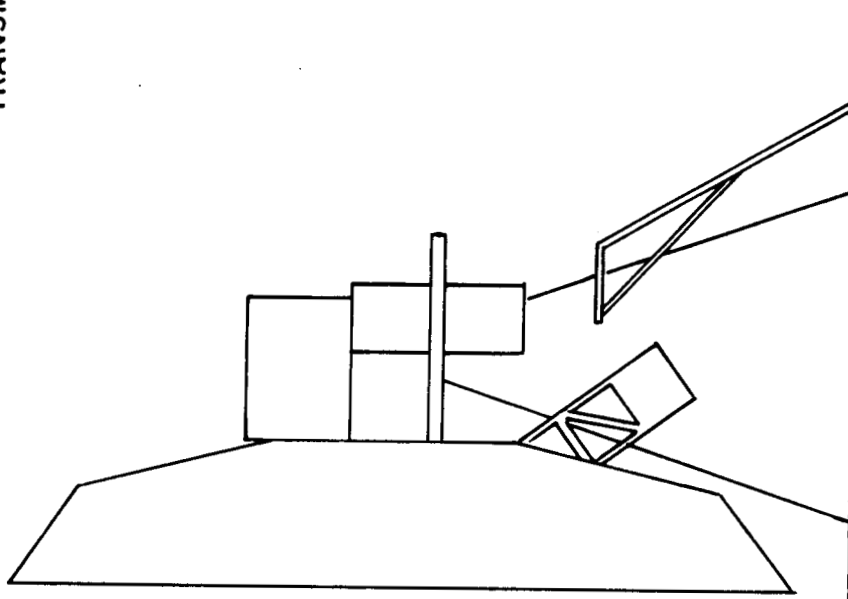


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TYPE MOUNT \_\_\_\_\_ AZ/EL

TRANSMISSION POWER \_\_\_\_\_ 450 KW



26 METER (85') ANTENNA BLDG G-52  
VENUS SITE

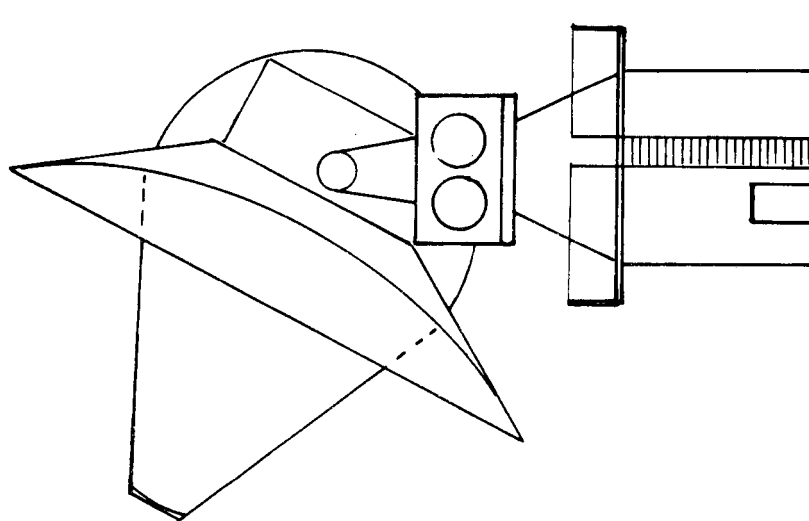
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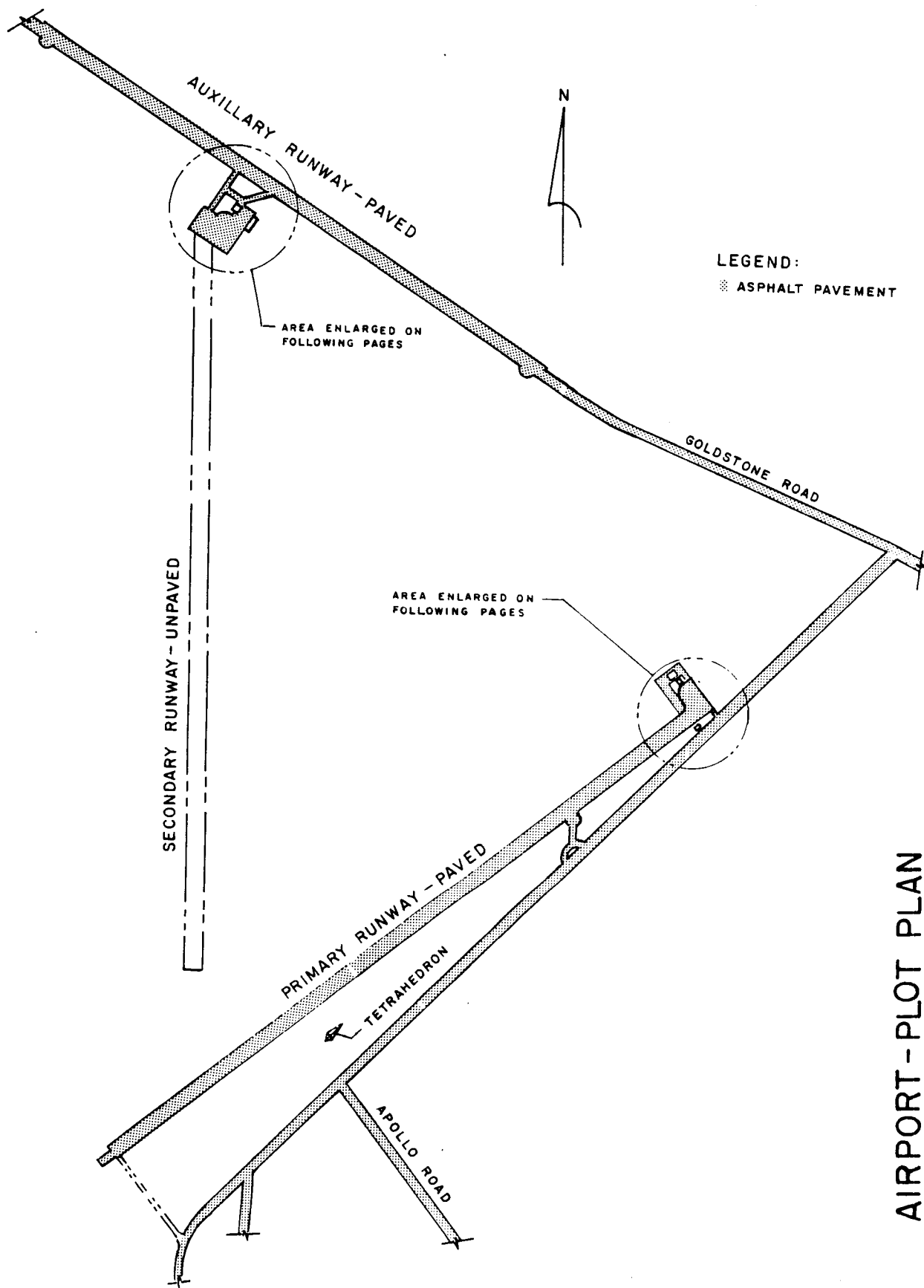
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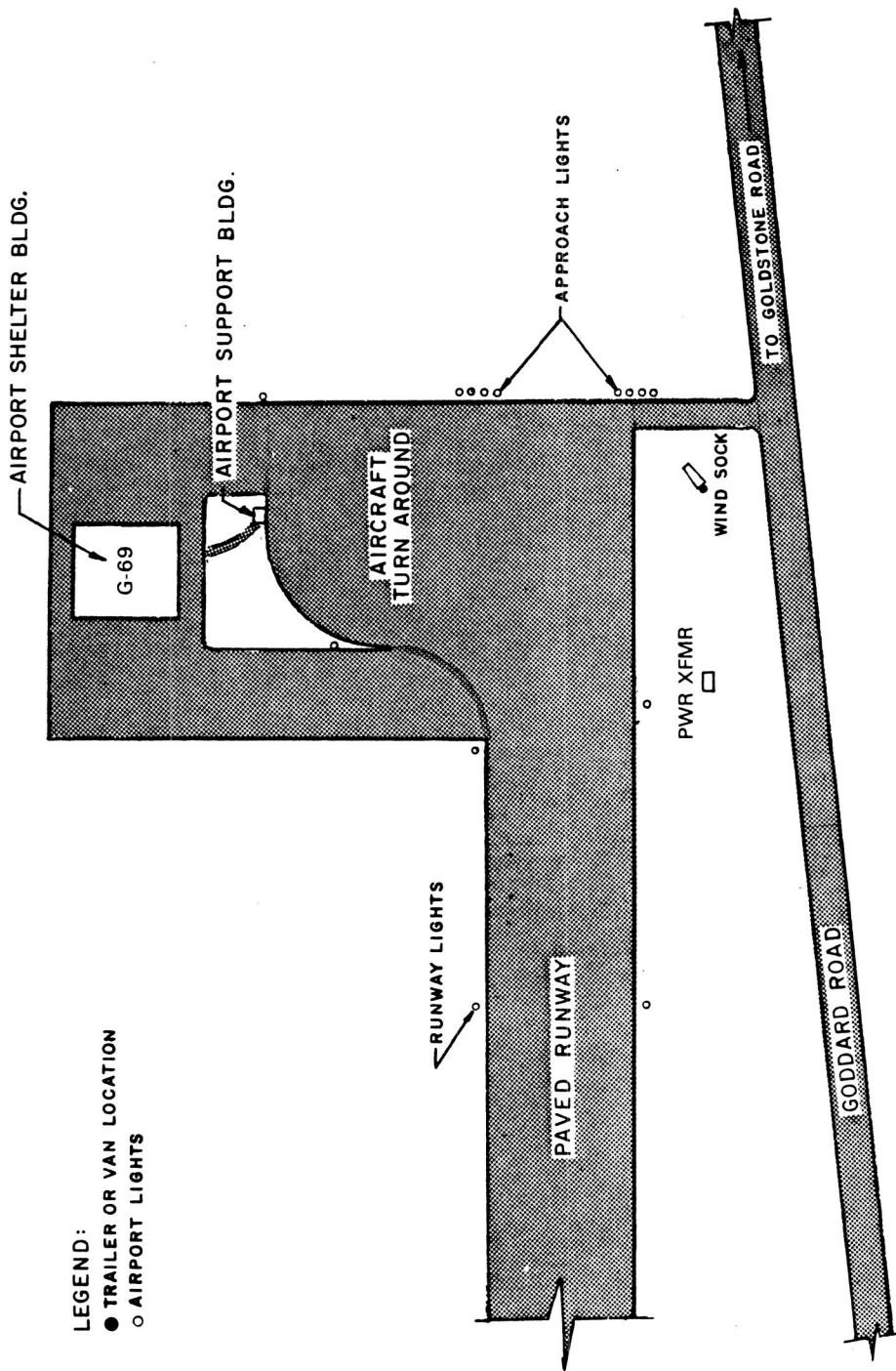
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E243°12'35"



9 METER (30') ANTENNA, BLDG. G-55  
VENUS SITE

SCALE: NONE





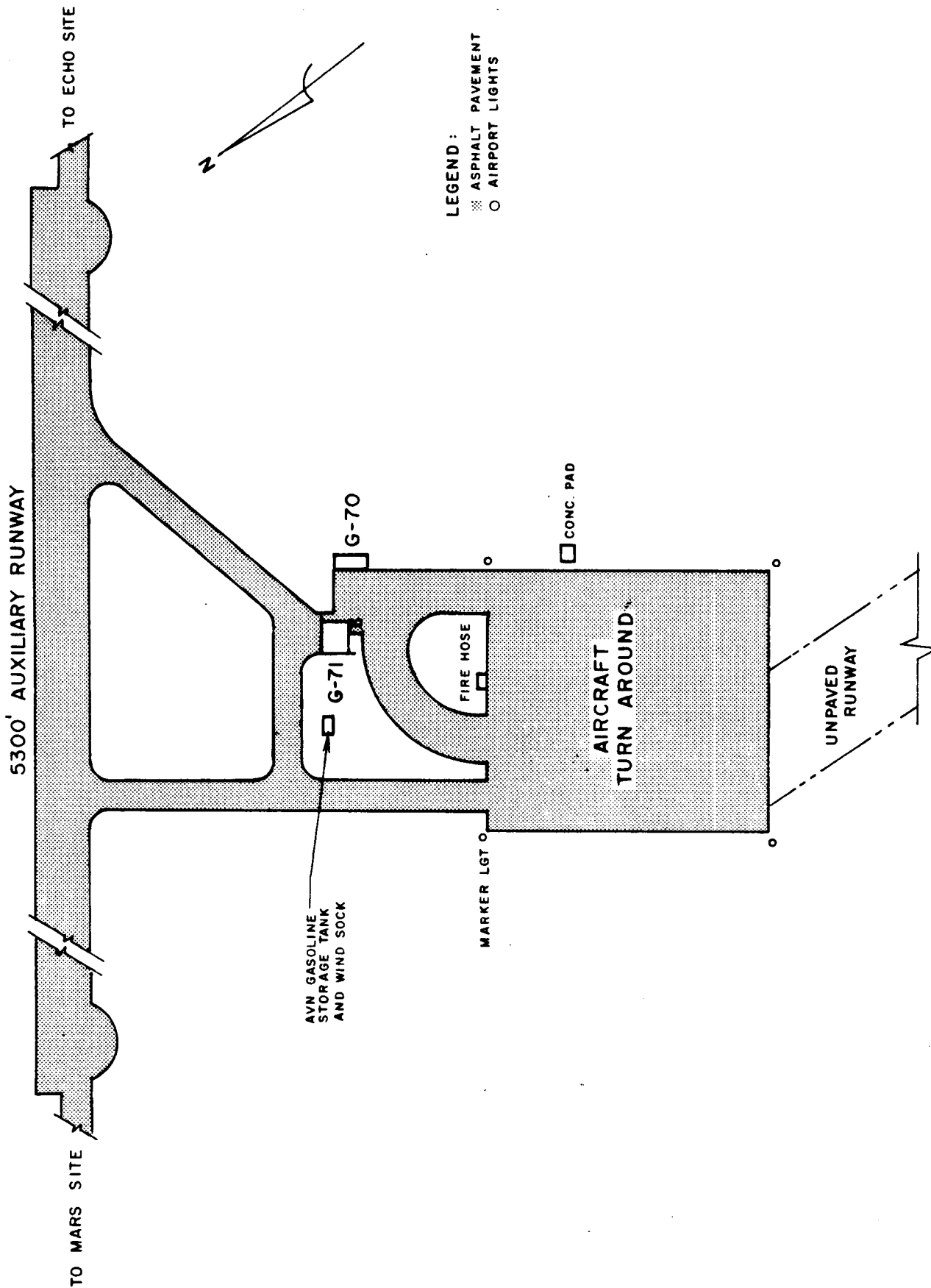
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- TRAILER OR VAN LOCATION
- AIRPORT LIGHTS

# AIRPORT TERMINAL - PAVED RUNWAY GOLDSTONE DRY LAKE

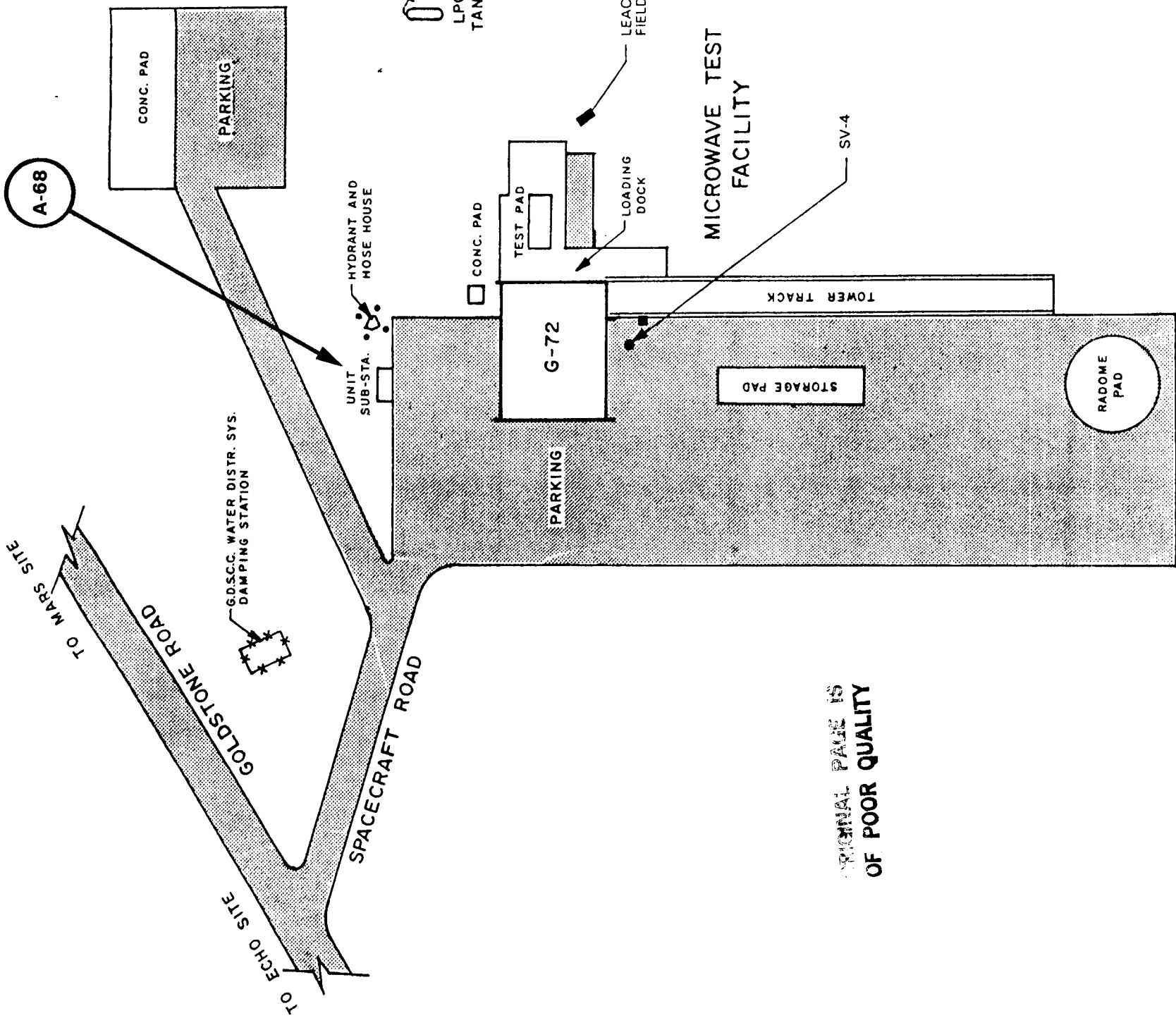
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# AIRPORT TERMINAL-UNPAVED RUNWAY GOLDSTONE DRY LAKE

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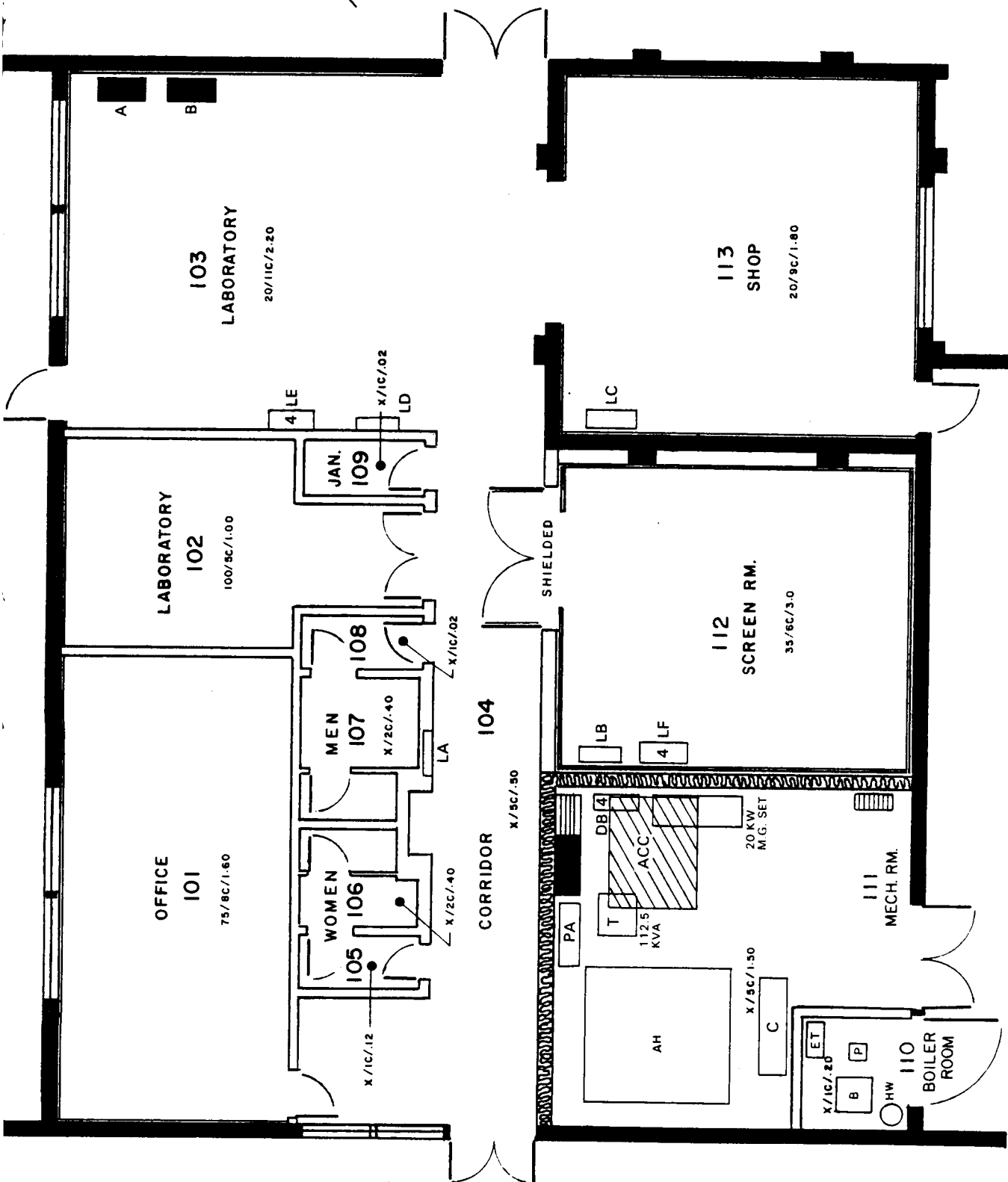


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Microwave Test Facility and Fire Training Area:  
Plot Plan



# MICROWAVE TEST FACILITY, BLDG G-72

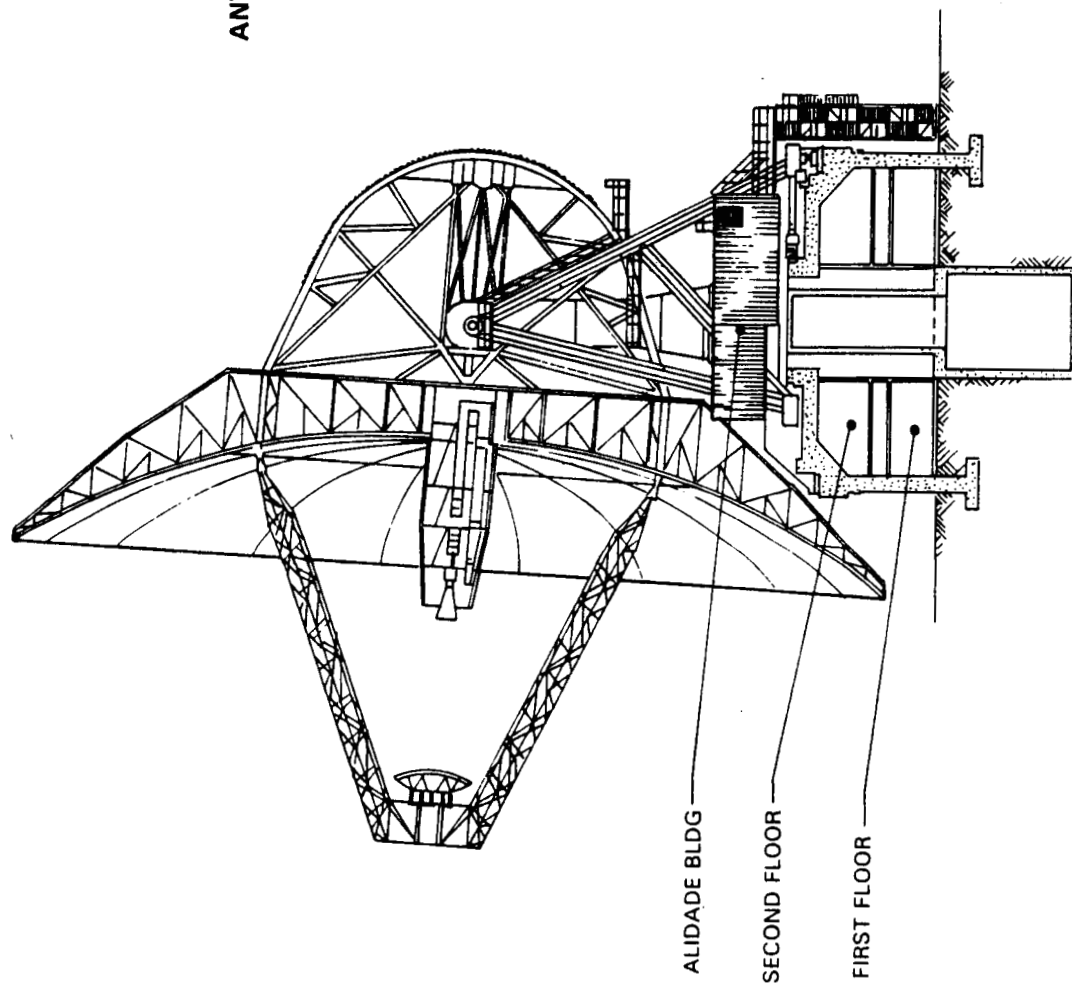
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ANTENNA DATA:

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TYPE MOUNT — AZ/EL  
TRANSMISSION POWER — 20 & 400 KW  
PEDESTAL DIAMETER — 82'  
COORDINATES: N35°25'33"  
E243°06'41"



64 METER (210') ANTENNA,\* BLDG. G-80  
MARS SITE

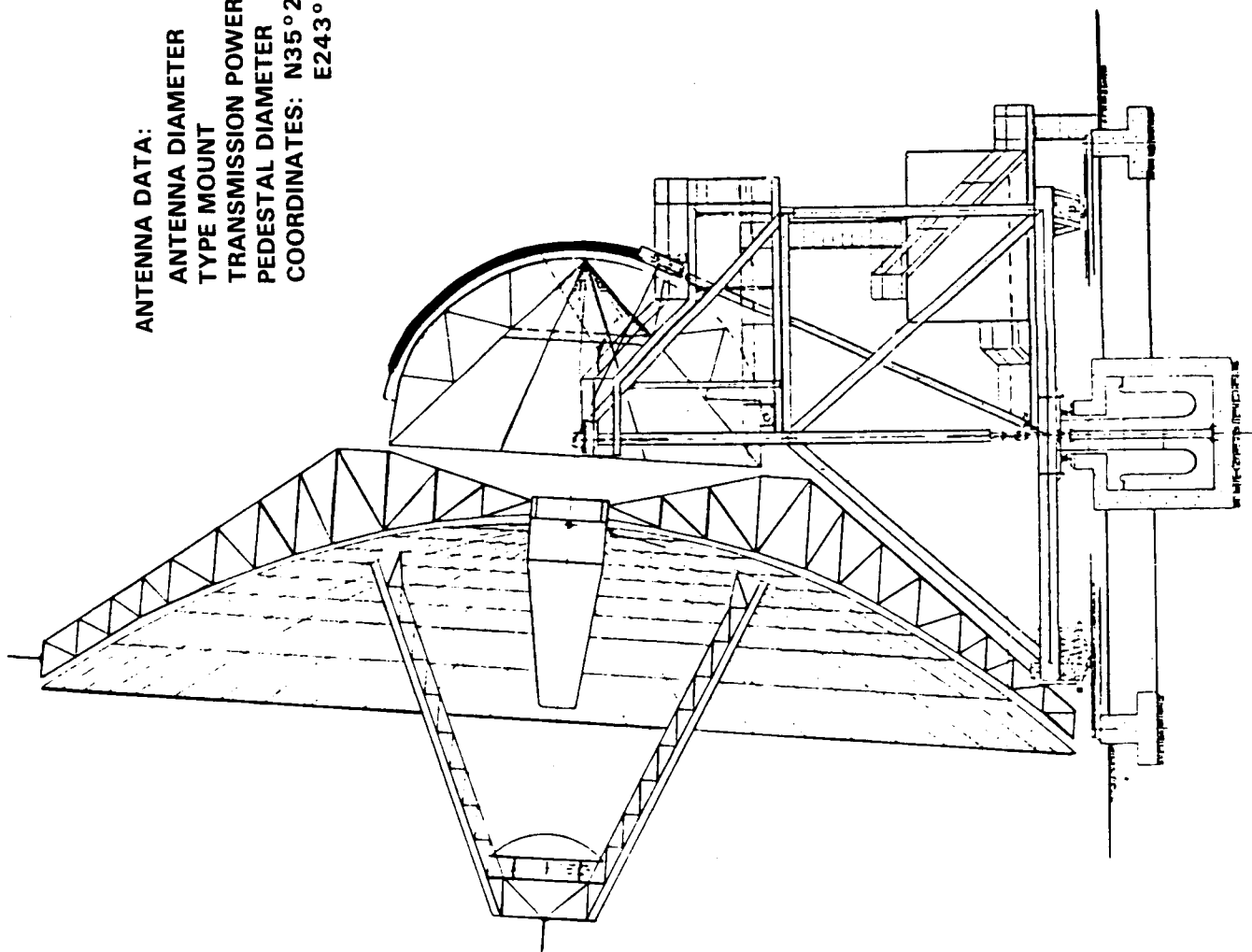
SCALE: NONE

\*In 1988, This Antenna was Enlarged  
to 70 Meters (230 ft)



ANTENNA DATA:  
 ANTENNA DIAMETER 34 METER (111.5')  
 TYPE MOUNT AZ/EL  
 TRANSMISSION POWER  
 PEDESTAL DIAMETER 19.6 METER (64.4')  
 COORDINATES: N35°25'19"  
 E243°06'49"

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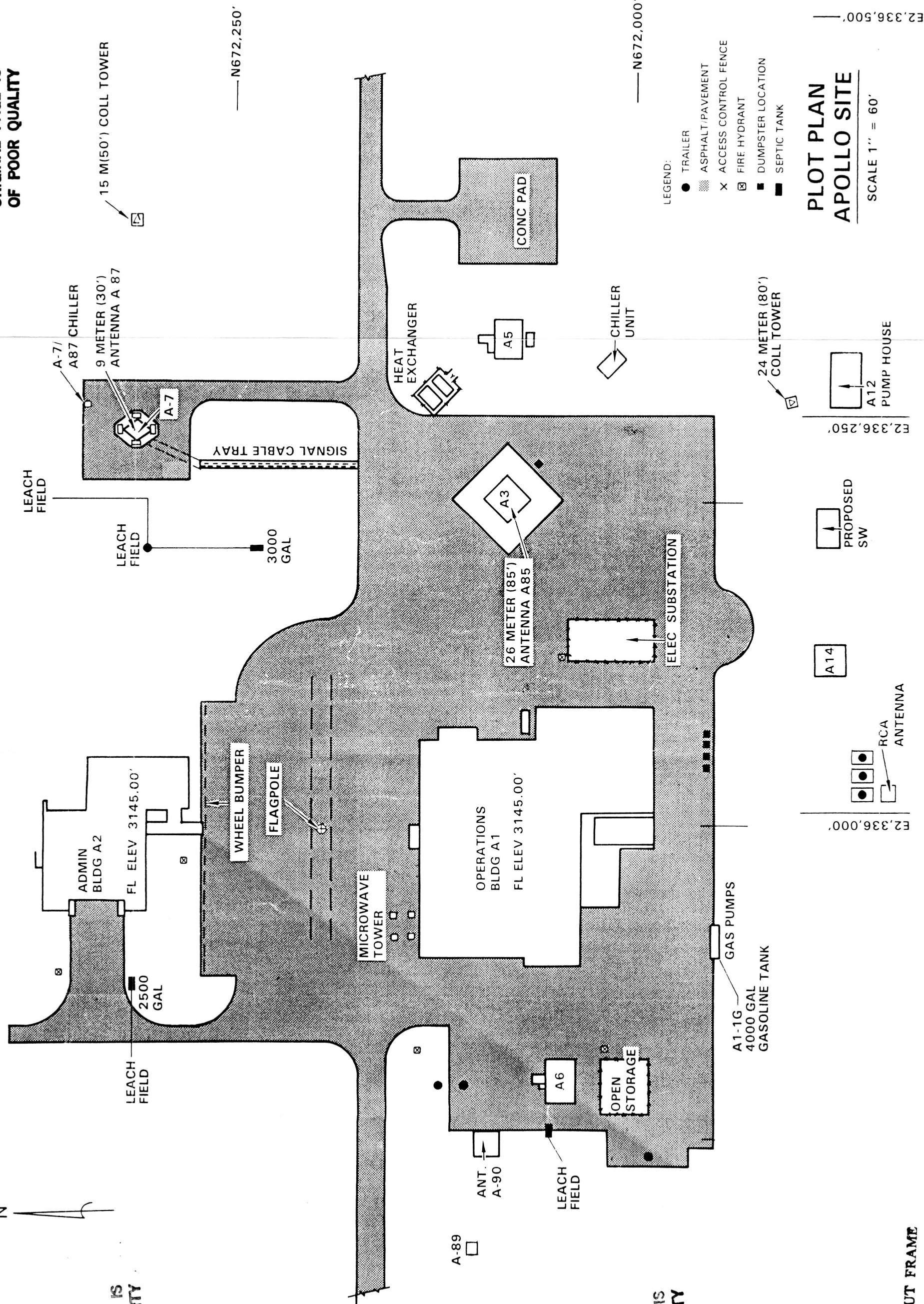
34 METER (111.5') ANTENNA, BLDG G-95  
 MARS SITE

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# PLOT PLAN APOLLO SITE

SCALE 1" = 60'

LEGEND:

- TRAILER
- ▨ ASPHALT/PAVEMENT
- X ACCESS CONTROL FENCE
- ☒ FIRE HYDRANT
- DUMPSTER LOCATION
- SEPTIC TANK

PROPOSED  
SW

A14

RCA  
ANTENNA

A12  
PUMP HOUSE

24 METER (80')  
COLL TOWER

CONC PAD

HEAT  
EXCHANGER

CHILLER  
UNIT

A5

A3  
26 METER (85')  
ANTENNA A85

ELEC SUBSTATION

OPERATIONS  
BLDG A1  
FL ELEV 3145.00'

MICROWAVE  
TOWER

FLAGPOLE

WHEEL BUMPER

ADMIN  
BLDG A2  
FL ELEV 3145.00'

LEACH  
FIELD

2500  
GAL

LEACH  
FIELD

3000  
GAL

LEACH  
FIELD

A-7/  
A87 CHILLER

9 METER (30')  
ANTENNA A 87

15 M(50') COLL TOWER

— N672,250'

— N672,000'

E2,336,500'

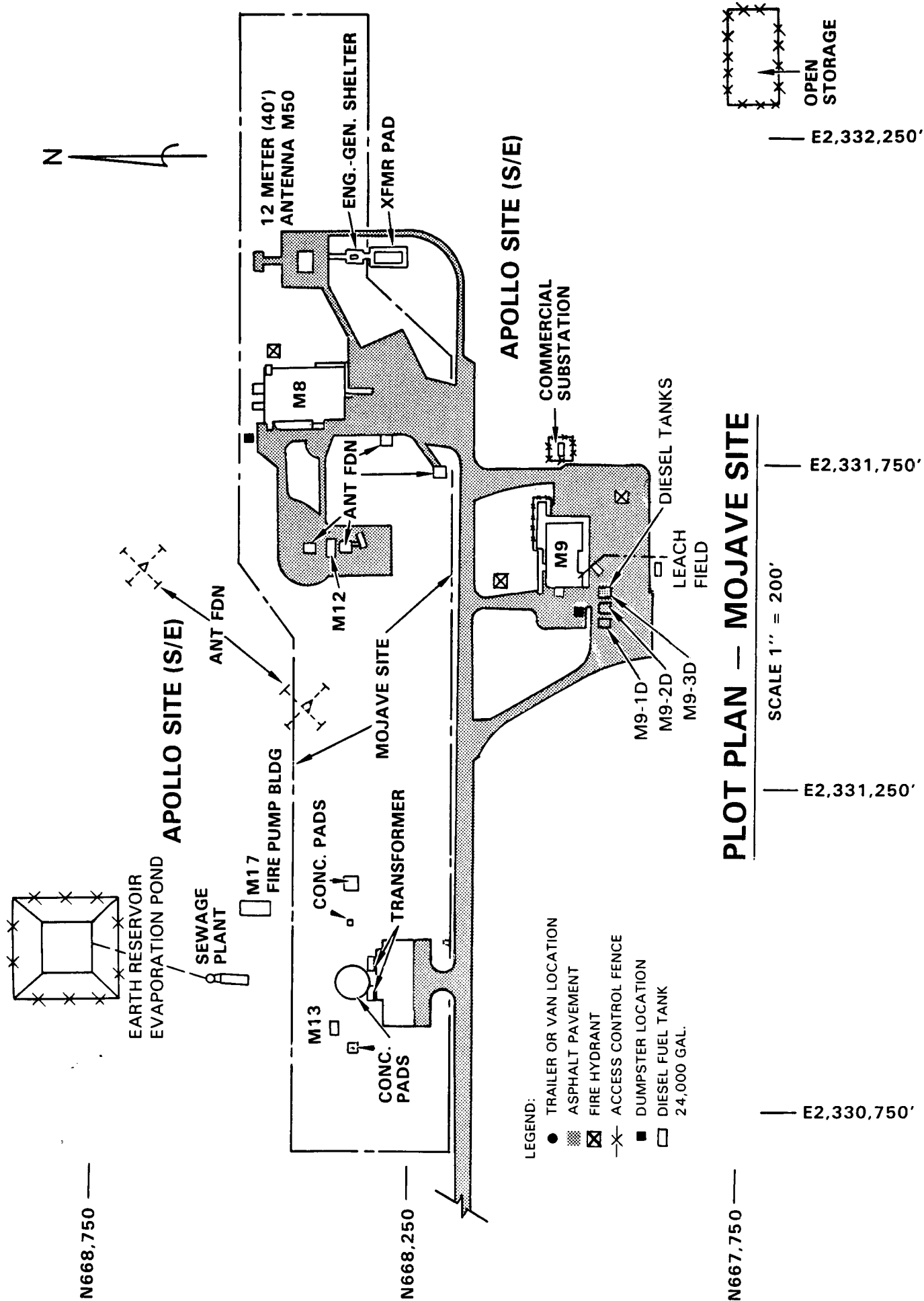
E2,336,250'

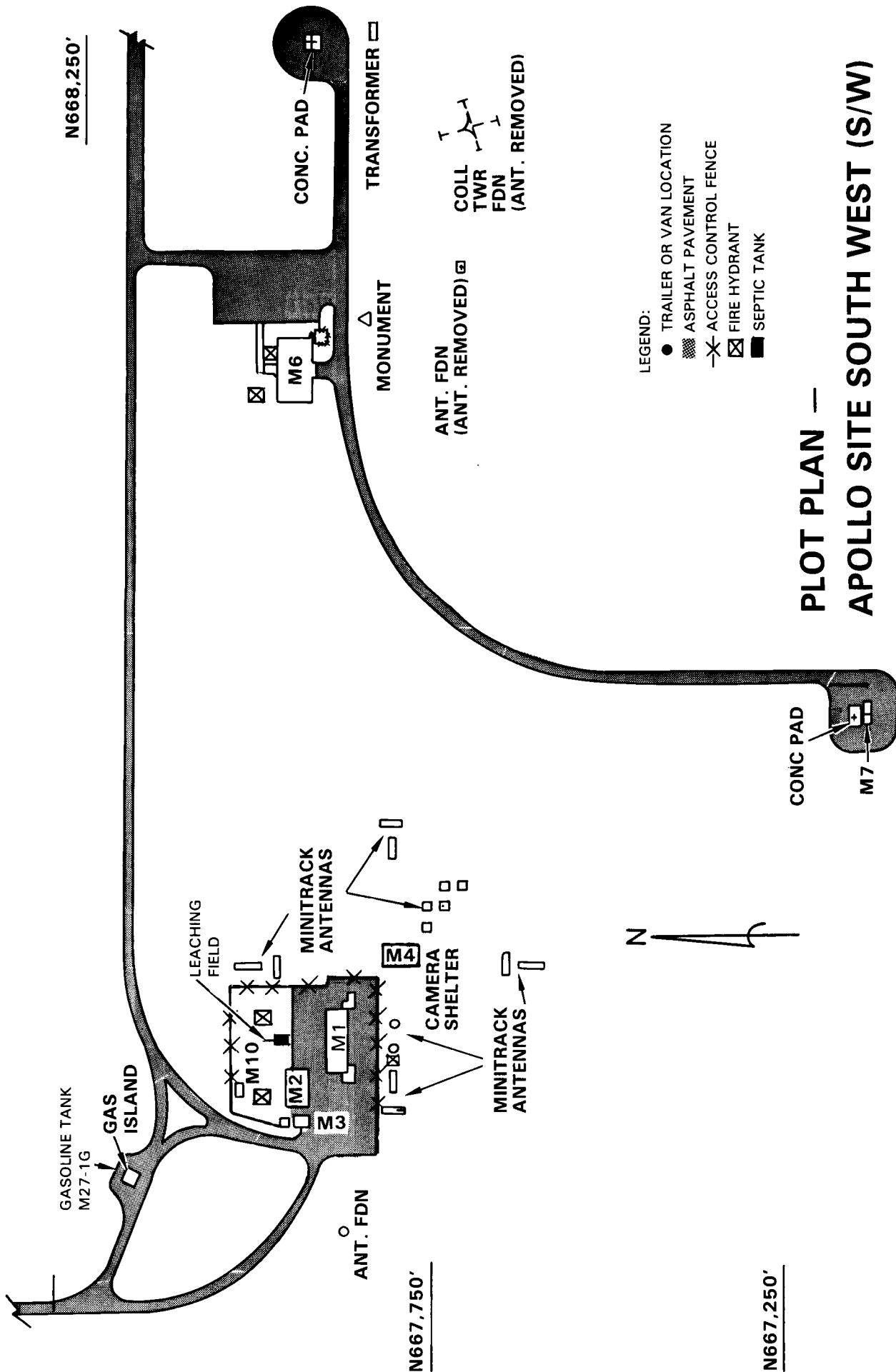
E2,336,000'

FOLDOUT FRAME

C-27

FOLDOUT FRAME





# **PLOT PLAN — APOLLO SITE SOUTH WEST (S/W)**

SCALE 1" = 200'

- LEGEND:
- TRAILER OR VAN LOCATION
  - ▨ ASPHALT PAVEMENT
  - X— ACCESS CONTROL FENCE
  - ☒ FIRE HYDRANT
  - SEPTIC TANK

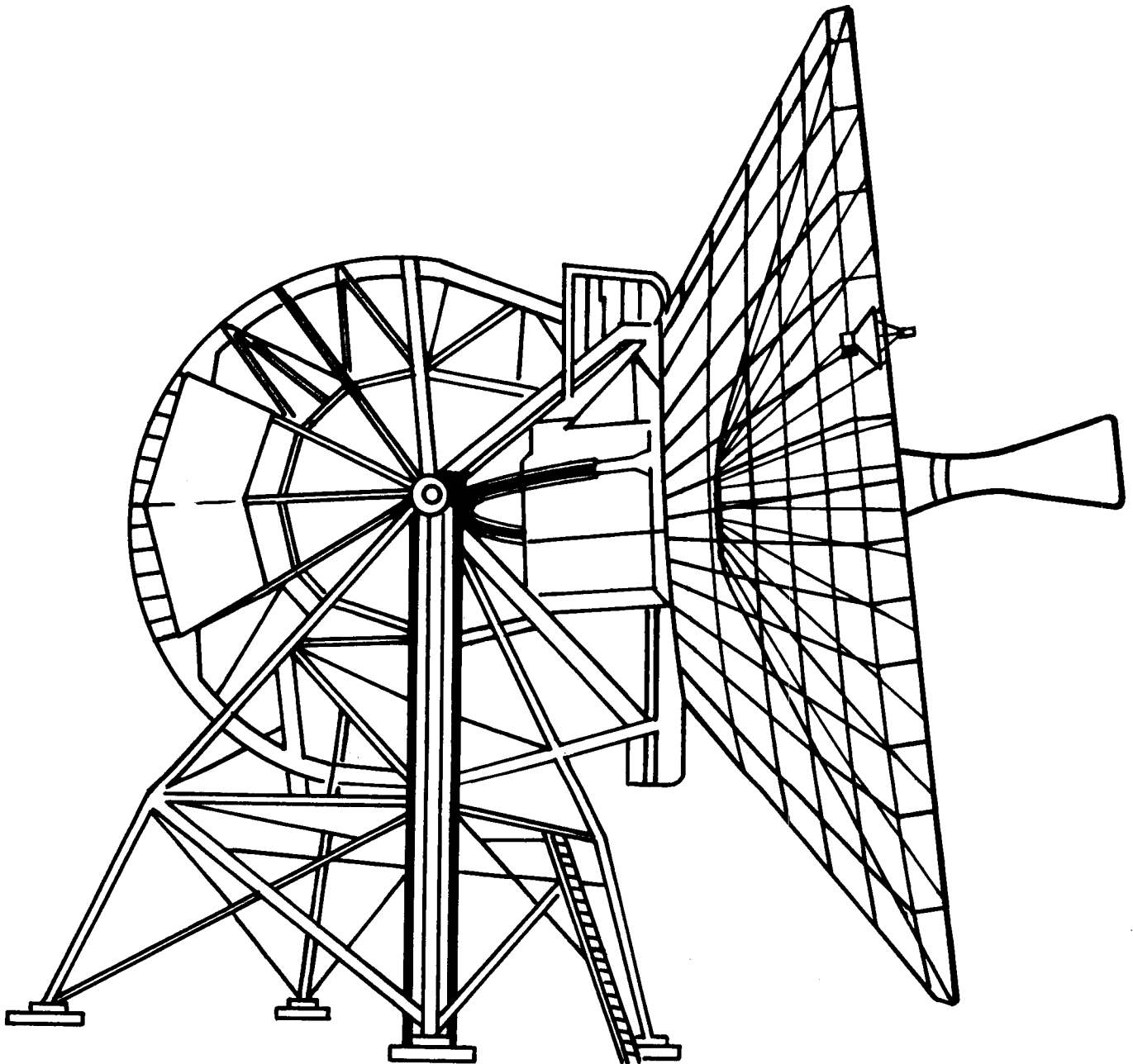
**ANTENNA DATA:**

**ANTENNA DIAMETER** \_\_\_\_\_ **26 METER (85')**

**TYPE MOUNT** \_\_\_\_\_ **X-Y**

**TRANSMISSION POWER** \_\_\_\_\_

**COORDINATES:**    **N35°20'30"**  
                              **E243°07'38"**



**26 METER (85') ANTENNA**  
**APOLLO STATION**

**BLDG A-85**

**SCALE: NONE**

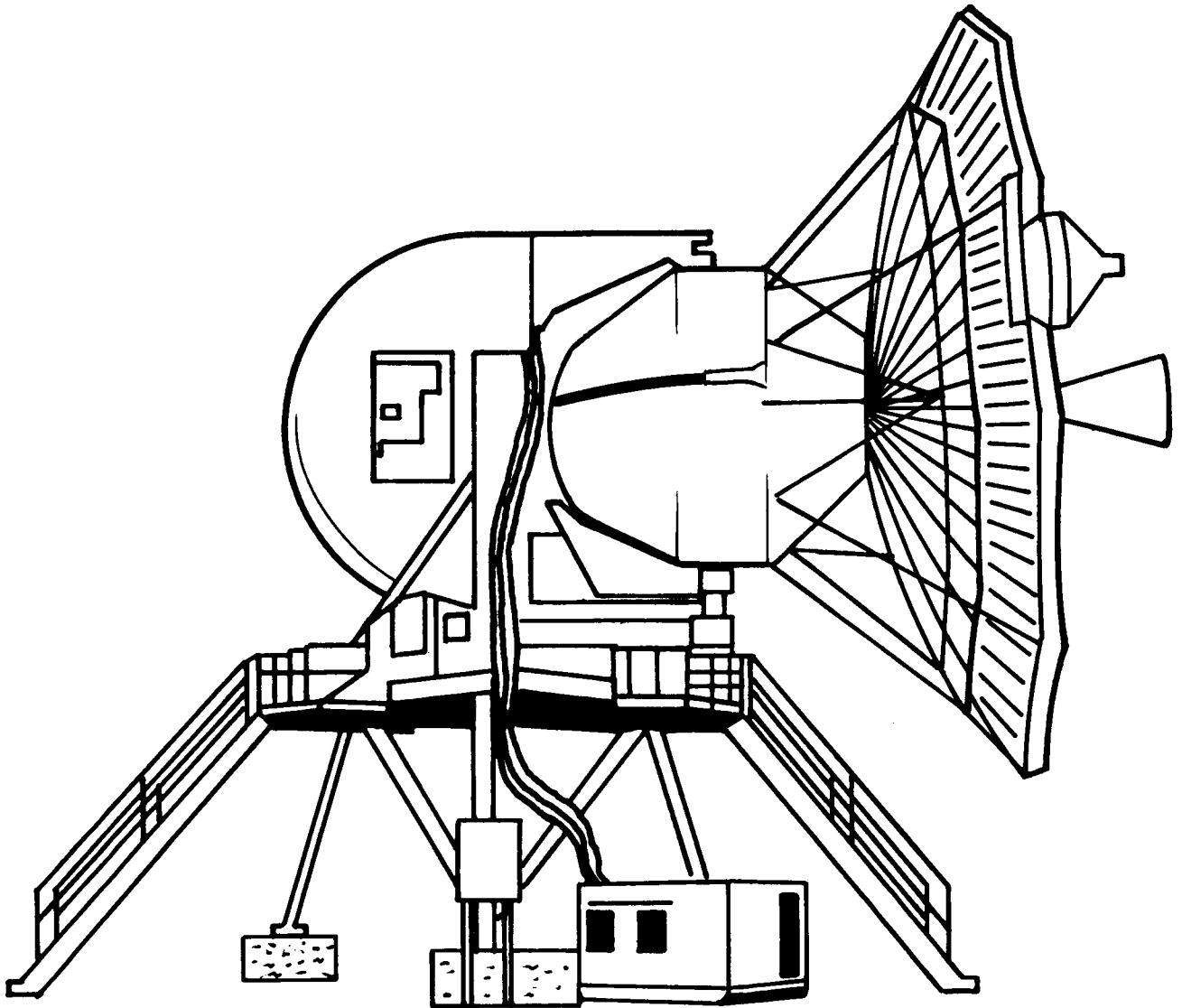
**ANTENNA DATA:**

**ANTENNA DIAMETER** \_\_\_\_\_ **9 METER (30')**

**TYPE MOUNT** \_\_\_\_\_ **X-Y**

**TRANSMISSION POWER** \_\_\_\_\_

**COORDINATES:**    **N35°20'37"**  
                          **E243°07'38"**



**9 METER (30') ANTENNA**  
**APOLLO STATION**

**BLDG A-87**

---

**SCALE: NONE**

ANTENNA DATA:

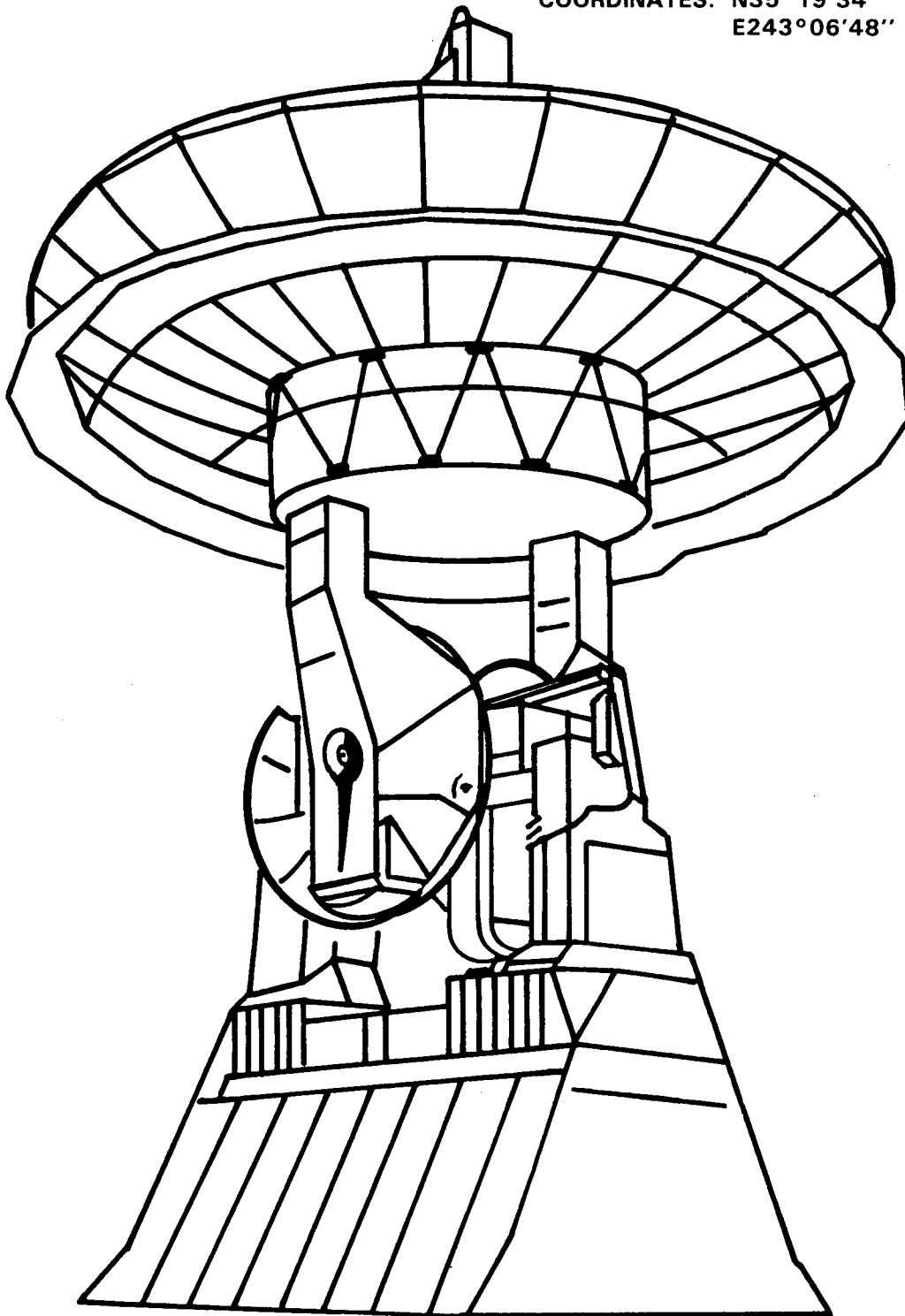
ANTENNA DIAMETER \_\_\_\_\_ 12 METER (40')

TYPE MOUNT \_\_\_\_\_ X-Y

TRANSMISSION POWER \_\_\_\_\_

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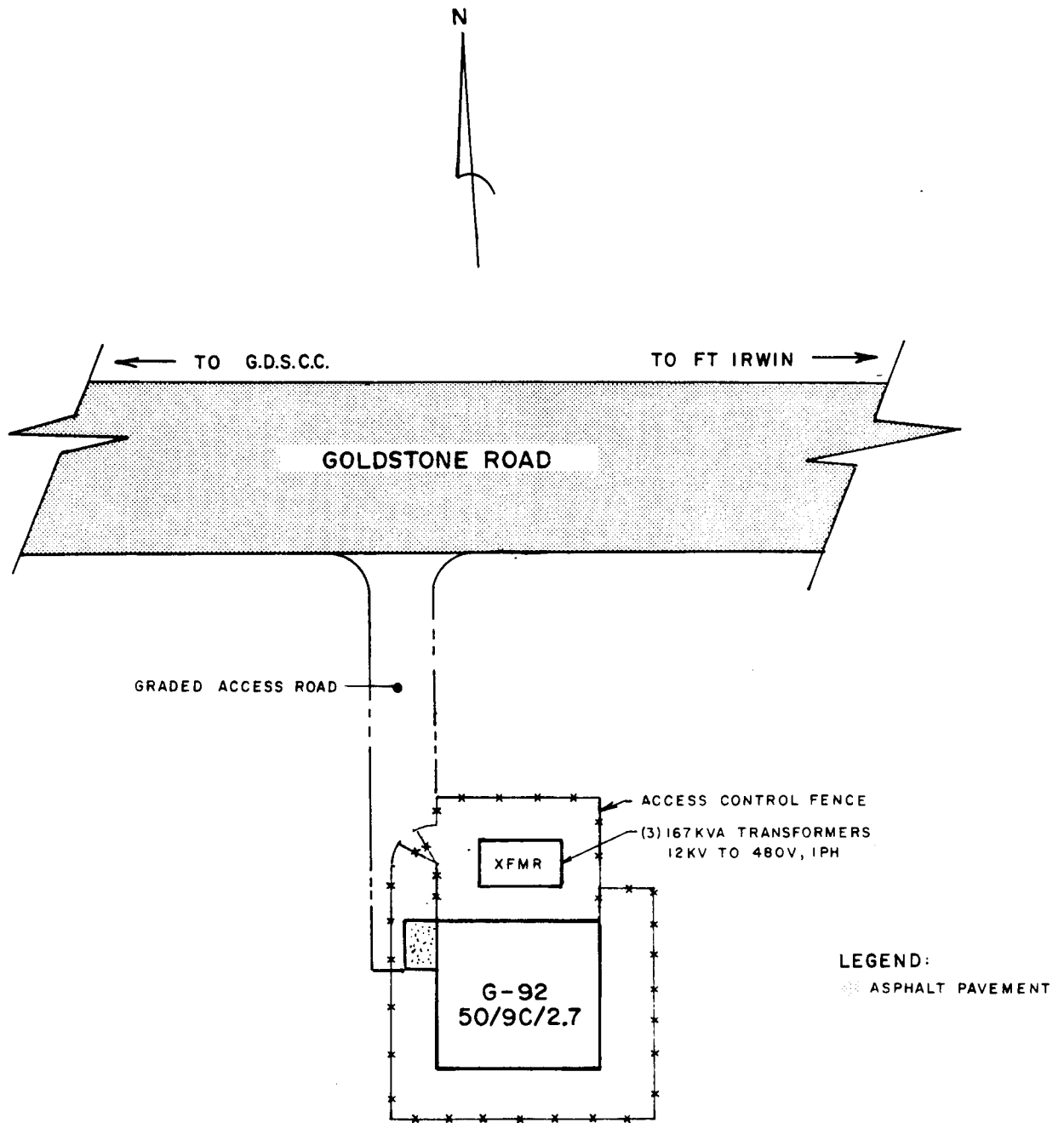
COORDINATES: N35°19'34''  
E243°06'48''



**12 METER (40') ANTENNA M-50  
MOJAVE SITE**

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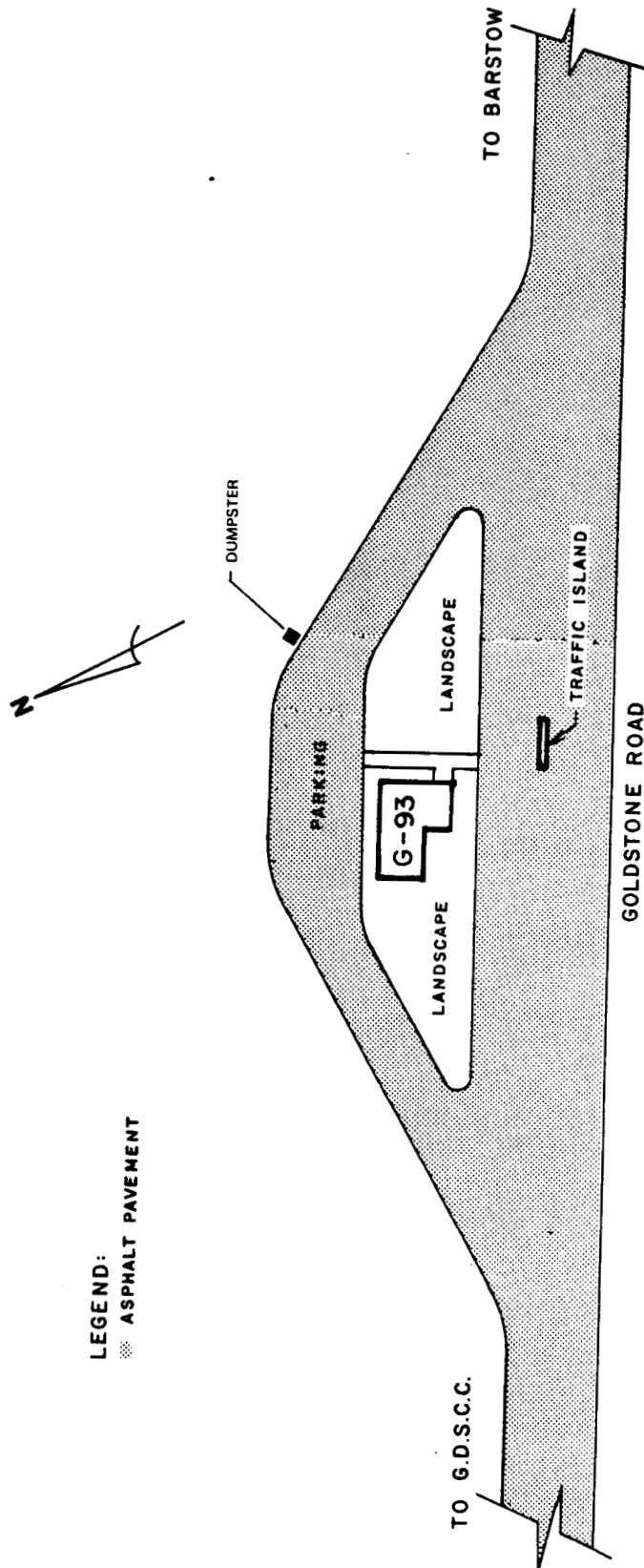
SCALE: NONE



# PLOT PLAN - COMPLEX PUMP HOUSE G.D.S.C.C.

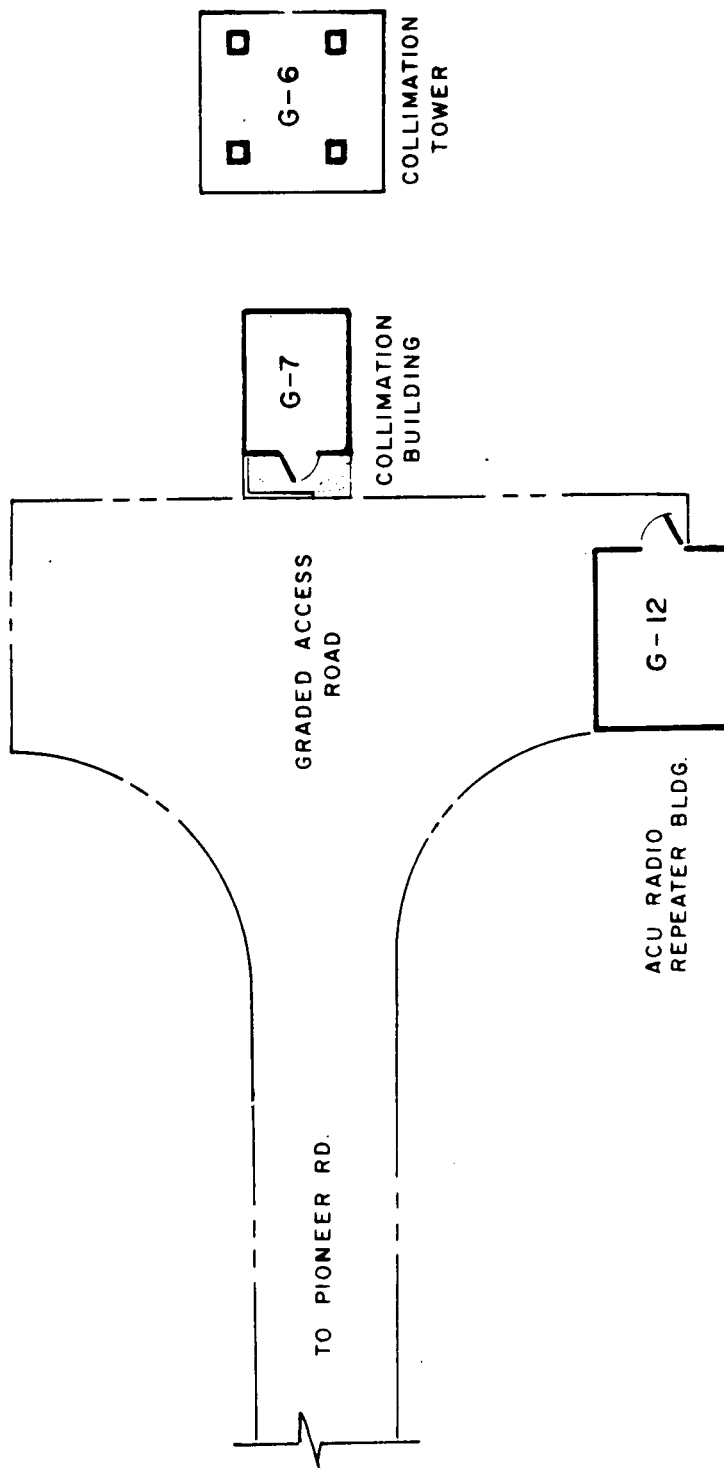
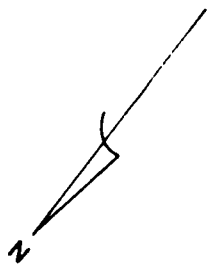
SCALE: 1" = 20'





# **PLOT PLAN — MAIN GATE HOUSE, G-93** **G.D.S.C.C.**

SCALE: 1" = 40'



PLOT PLAN  
COLLIMATION TOWER G-6  
PIONEER SITE  
SCALE: 1/16" = 1'-0"

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<p>16. Abstract</p> <p>The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 150 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The goldstone complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Insitute of Technology in Pasadena, California. A detailed description of the GDSCC is presented in Section II of this report.</p> <p>The GDSCC includes five distinct operational areas named Echo Site, Venus Site, Mars Site, Apollo Site, and Mojave Base Site. Within each site is a Deep Space Station (DSS) that consists of a large parabolic dish antenna and its support facilities.</p> <p>As required by NASA directives concerning the implementation of the National Environmental Policy Act (NEPA), each NASA field installation shall publish an environmental resources document (ERD) that describes the current environment at the installation and also includes any effects that NASA operations may have on the installation's environment.</p> <p>M.B. Gilbert Associates (MBGA), Long Beach, California, was retained by JPL under Contract No. 957925-71070 to prepare the required ERD for the GDSCC.</p>					
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